NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

Experimental Study ND 98-06

**Fabric Reinforced Backfill
Under Approach Slabs**

Final Report

PROJECT NH-4-002(051)138

August 2004

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
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RCS HHO-30-19

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

<table>
<tr><td rowspan="2">EXPERIMENTAL PROJECT</td><td colspan="3">EXPERIMENTAL PROJECT NO.
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NH-4-002(051)138
8</td><td>LOCATION
Ward County</td></tr>
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51 X No</td></tr>
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145 BRIDGESUBSTRUCTURES</td><td colspan="3">KEY WORD 2
167 APPROACHES</td></tr>
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189</td><td colspan="3">KEY WORD 4
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3 SY-IN   7 EACH
4 CY   8 X LUMP SUM
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4 MARGINAL
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1 ADOPTED AS PRIMARY STD.   4 PENDING
2 X PERMITTED ALTERNATIVE   5 REJECTED
3 ADOPTED CONDITIONALLY   6 NOT CONSTRUCTED
(Explain in remarks if 3, 4, 5, or 6 is checked)</td></tr>
<tr><td>REMARKS</td><td colspan="5">321 The R1 reinforcement fabric used to wrap the select backfill failed to meet strength specifications, but was not removed. A drop in height from the asphalt to the approach slab, causes unnecessary dynamic impacting of the approach slab and bridge. Settlement at the beginning of the approach slabs after 5 years was 3.0” for the Experimental Section and 1.6” for the Control Section. This was after maintenance patches were applied to reduce the bump. The approach slabs were mudjacked in 2003 to original elevations.</td></tr>
</table>

Form FHWA 1461

Experimental Study ND 98-06

Fabric Reinforced Backfill Under Approach Slabs

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Written by
Mike Marquart

Disclaimer

Table of Contents

EVALUATION OF FABRIC REINFORCED BACKFILL UNDER APPROACH SLABS

Background

A bump often develops at the ends of a bridge near the interface of the abutment and the embankment or if an approach slab is used, between the end of the approach slab and the embankment. Reduction in steering response, distraction to the driver, added risk and expense to maintenance operations, and reduction in a transportation agency's public image are all undesirable effects of these uneven irregular transitions. A bump that is allowed to persist increases the chance of damage to the bridge deck from the dynamic impact of vehicles. These impact loads have been estimated to be four or five times larger than the static loads; "Hu, Y., T. Wu, C. E. Lee, and R. Machemehl, *Roughness at the Pavement-Bridge Interface*, Report No. 213-1F, Texas State Department of Highways and Public Transportation, Austin, Texas (August 1997) 157 PP". Damage to the bridge deck can also be caused by snow plows in the winter. In addition, the bump can cause damage to vehicles.

The bump at the end of the bridge is a complex problem involving a number of components, including the natural soil on which the embankment and the abutment are built, the approach fill material, the foundation type used for the bridge abutment, the abutment type, the structure type, the bridge/roadway joints, the approach slab, the roadway paving, and the construction methods. The problem affects twenty-five percent of the bridges in the United States, approximately 150,000 bridges. Each year, the amount of money spent on this problem nationwide is estimated to be at least $100 million. Survey results indicate that integral bridge abutments appear to be a special case where a bump is consistently created resulting from temperature cycles and the associated compression and decompression of the approach fill by the abutment wall.

Objective

The conventional method of constructing the embankment behind an abutment wall has not prevented the bump at the end of the bridge to any great degree. The objective of this experimental feature is to build a better foundation under the approach slab that will eliminate the bump at the interface of the approach slab and the asphalt pavement. See Figure 1

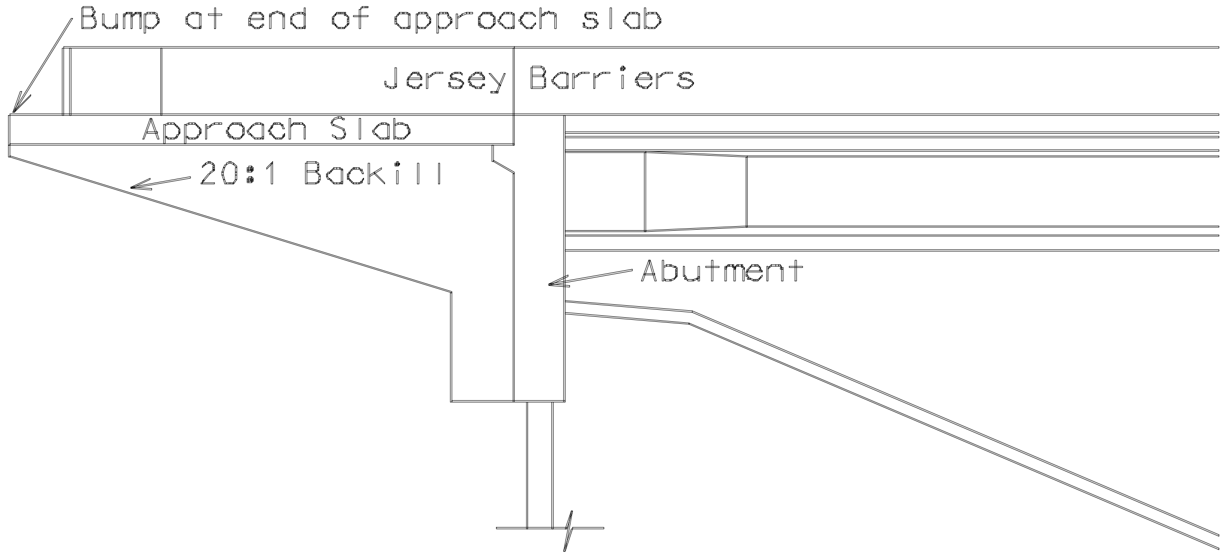
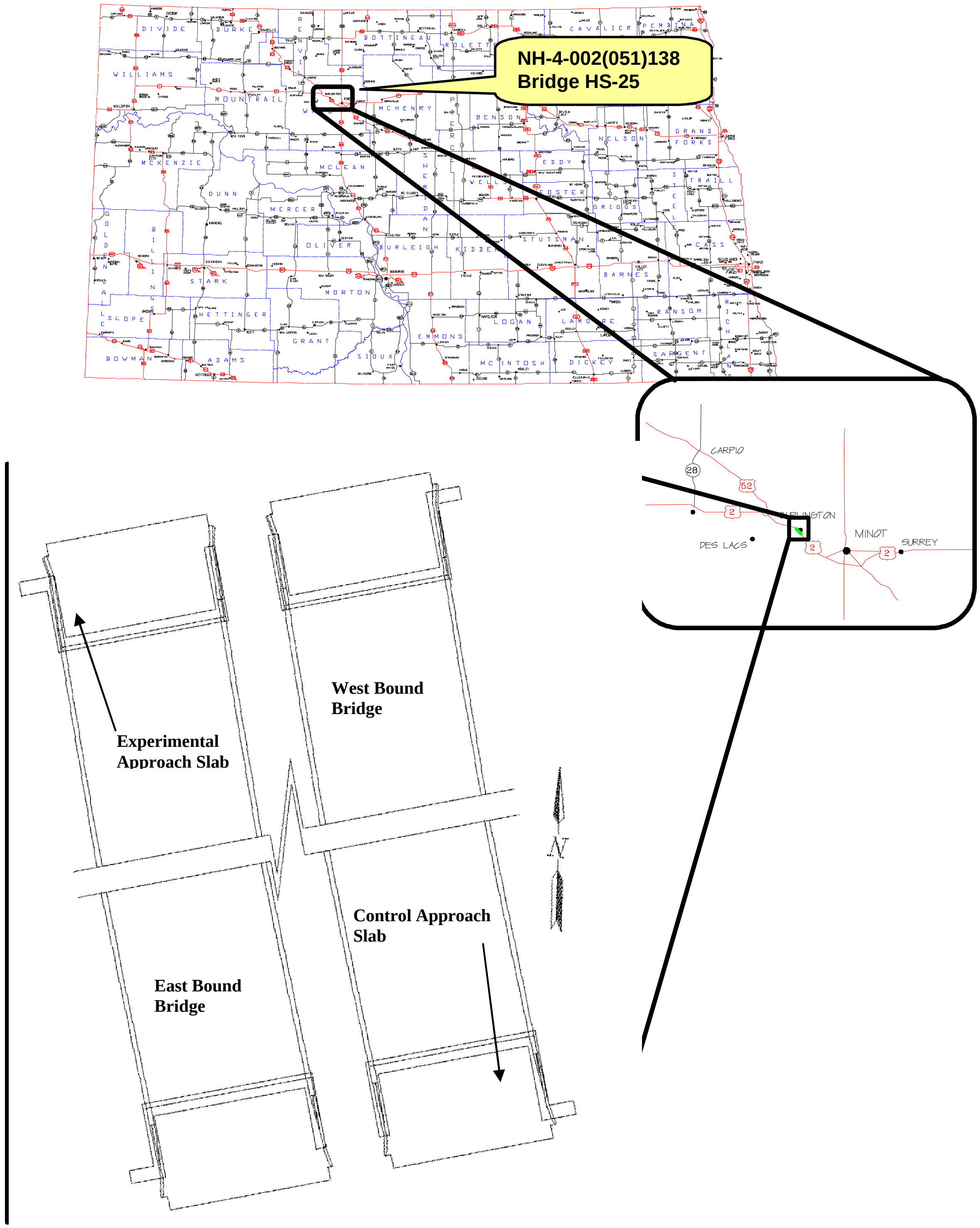


Figure 1 Proposed detail of experimental feature

Location

This experimental feature is located on the Burlington Separation Bridge Project NH-4-002(051)138. It will be constructed on the approach end of the bridge in the eastbound lanes. The approach slab on the bridge of the westbound lanes will be used as a control. Project plan sheets and typical sections are found in Appendix A.


NH-4-002(051)138
Bridge HS-25
CARPIO
28
52
2
DES LACS
MINOT
SURREY
West Bound
Bridge
Experimental
Approach Slab
Control Approach
Slab
East Bound
Bridge
N

Project History

Traffic

Year		Pass>Car	Trucks	Total	Flexible ESALs - Two Way
Construction	1998	4,750	550	5,300	440
Evaluation	1999	4,750	550	5,300	440
Evaluation	2000-2001	4,800	600	5,400	505
Evaluation	2002-2003	3,765	795	4,560	645

Table 1

NDDOT Roadway Information Management System (RIMS) Historical Data

Year	Thickness	Type	Width
1979		Structure —Steel Culvert (33x22x326)	
1979		Grade	48'
1979		84 feet c-c	
1980	8.0"	Aggregate Base	42'
1980	2.0"	Hot Bituminous Pavement 120-150	30'
1980	1.5"	Hot Bituminous Wearing. Course 120-150	27'
1992	1.0"	Milling	24'
1992	5.0"	Hot Bituminous Pavement 120-150	28'
1992		Finished Roadway Width	37'

Table 2

Design

The design carries the select backfill at a 20:1 taper from the abutment all the way back until it intercepts the pavement section. The new design shows installing a void form against the abutment and building what is essentially a retaining wall against the void form. The form is later washed away to leave a 3” to 4” void that will allow the abutment to move without affecting the select backfill. Geotextile reinforcement fabric is to be used and the select backfill is to be compacted in one foot layers. The geotextile fabric is also required to be wrapped back on the sides with each foot of fill. A drainage system behind the abutment is also provided.

Design details showing the fabric reinforced backfill under the approach slab are located in Figures 2 and 3. They are also shown in Appendix B. This experimental feature was change ordered on to project NH-4-002(051)138. The change order 2p is located in Appendix B.

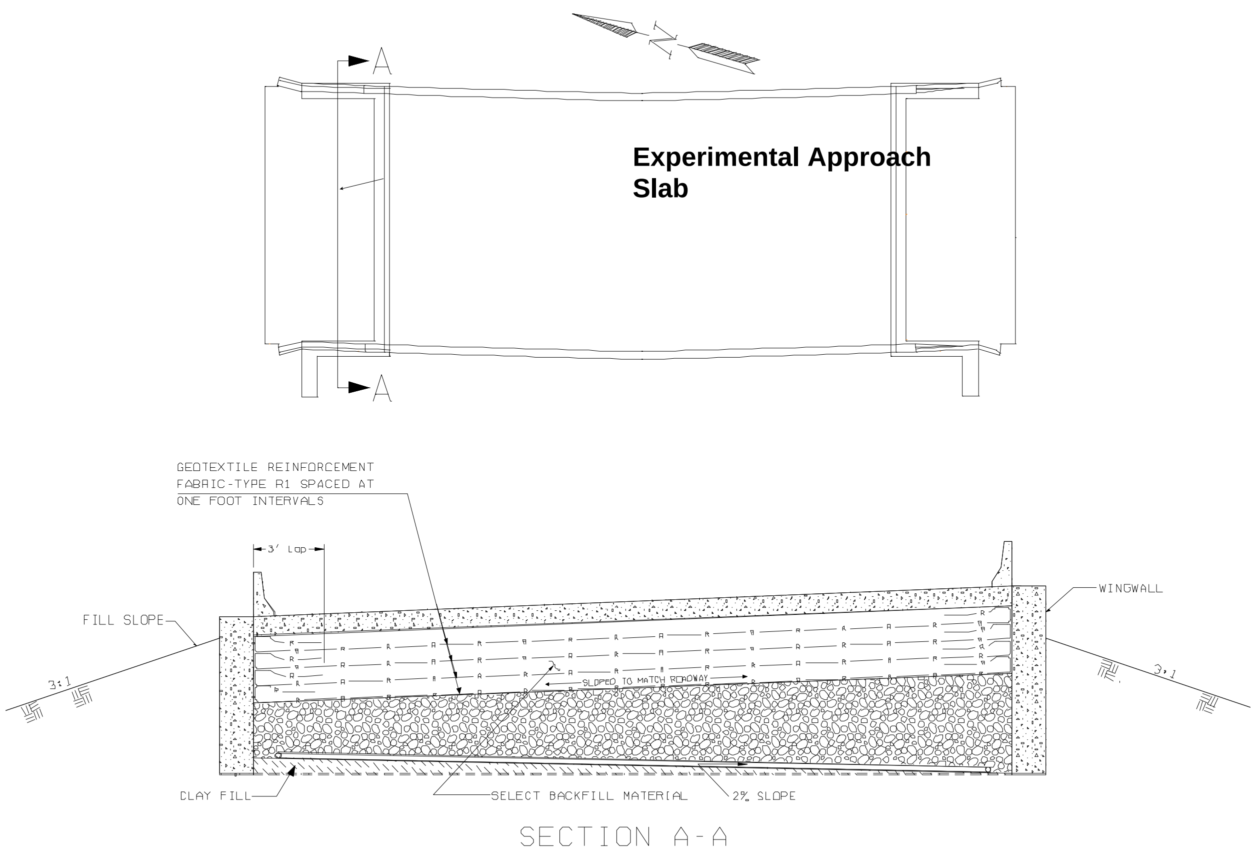


Figure 2 Detail for Fabric Reinforced Backfill under the Approach Slab

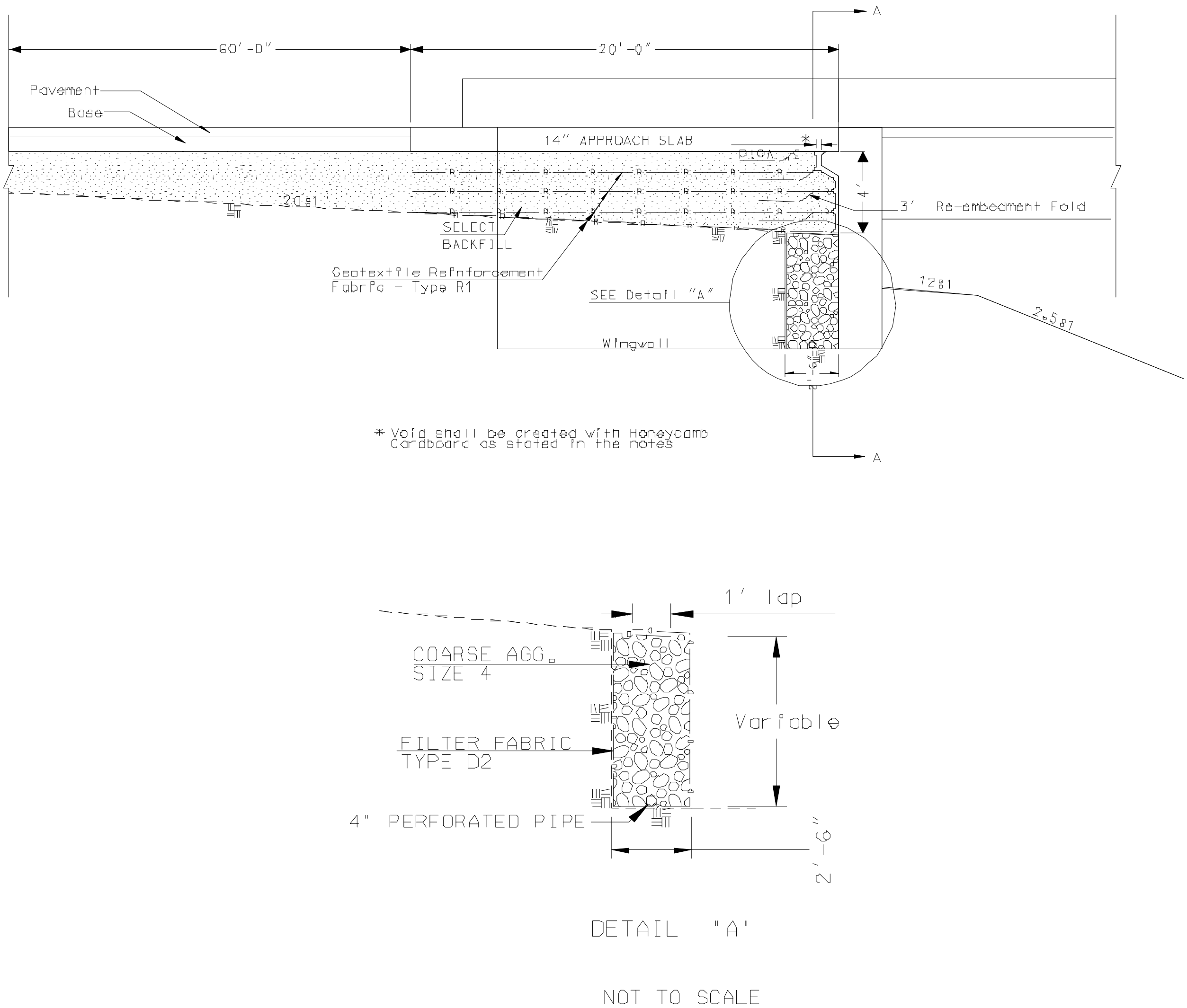


Figure 3 Detail for Fabric Reinforced Backfill under the Approach Slab

Although there is no typical drawing for the Control Section, compaction and density control for the Control Section was in accordance with Section 203.02 G of the Standard Specifications T-180. The embankment is placed in horizontal layers not exceeding 12 inches and compacted to the specified density before the next layer is placed. The soil layers are compacted to 85% of the maximum dry density as determined by AASHTO T-180. Soil moisture at the time of compaction shall be not less than the optimum moisture content and no more than 5 percentage points above the optimum moisture content.

Construction

Construction began on March 30, 1998 and was opened to traffic on October 27, 1998. Ron Harris Construction removed the common excavation waste material over the Structural Plate Pipe (SPP) tunnel and rough graded the 20:1 taper section at the same time. The 20:1 sections were roughly graded for the approach and end slabs. Industrial Builders then excavated for the abutments and fine graded the 20:1 sections. Abutments were poured and grading was performed for the installation of the 4" drainage system.

The drainage system was installed according to the plans. A 4" PVC perforated pipe was used and covered with size 4 drainage rock which was protected by D2 type geotextile fabric. The drainage rock that was used with the perforated PVC pipe was installed at the same time as the select backfill was installed. There was no way the drainage rock could be installed without bringing the select backfill up with it at the same time. The non-perforated PVC pipe lengths had to be adjusted to fit the existing slopes around each abutment.

The following pictures show construction of the experimental section under the approach slab of abutment 1 of the eastbound Bridge.

Photo 1 – Tacking R1 fabric before placement of the next one foot of select fill.

Photo 2 – Select fill placed over fabric wrap.

Photo 3 – Cutting void form for installation against abutment wall.

Photo 4 – Asphalt meets approach slab of the control section.

A class 5 material was tested and met the requirement for select fill. The test worksheet is located in Appendix B. The 3" void material was not available in such small quantities and an alternate 4" void form was used.

Geotextile fabrics were used to wrap the drainage system and in the select backfill. A D2 type filter fabric was used to wrap the 4" drainage system. R1 reinforcement fabric was used to wrap each 1' lift of select backfill until the required height was reached.

The approach slab was formed and poured over the experimental section at the same time as the bridge deck. The approach slab is 14" thick. Appendix B contains the concrete proportion design and compression test of a concrete cylinder for the approach slab. The roadway was paved with asphalt up to the approach slab. Photos were taken after the project was completed. Photos 4 and 5 show the approach slab of abutment 4-westbound bridge (control section). Photo 5 shows that the slab is in good condition and that the joint looks good.

Photo 5 – Approach slab meets bridge in the control section – Westbound Bridge.

Photo 6 shows a view looking west at the experimental approach slab of the eastbound bridge of the Burlington bridges. These bridges have been open to traffic for about one day. Photo 7 shows the beginning of the approach slab and surface tining. A slight dip was noticed where the asphalt meets the concrete, but appears not to affect the ride as observed from the side of the road.

Photo 6 - Overview of experimental approach slab – Abutment 1 Eastbound Bridge.

Photo 7 – Asphalt meets approach slab of the experimental section.

Photo 8 shows where the approach slab on the left side of the photo meets the bridge on the right.

Photo 8 – Approach slab of the experimental section meets the bridge.

An elevation survey was conducted of the finished experimental approach slab and transition. This is to aid in the annual evaluation of the experimental project. A copy of the survey is located in Appendix C. The elevation survey did not include the control section in 1998.

Cost

The experimental section required 4 feet of select backfill which is about 2.5 feet less than would have been used in a standard design. The following is a break-down of the costs of the experimental section approach slab and a control or a conventionally built approach slab.

Abutment 1 - eastbound bridge entrance approach slab (Experimental Project)

Select Backfill (4 feet @ 20:1) = 337.7 CY x $12/CY	$ 4,052.40
Underdrain Pipe - PVC Perforated - 4in = 68 LF x $14/LF	$ 952.00
Underdrain Pipe - PVC Non-perforated - 4in = 54 LF x $14/LF	$ 756.00
Cost of fabric, extra drainage rock and void form	$ 5,327.14
Cost subtracted for failing fabric	$ -735.15
Total	$ 10,352.39

Abutment 4 -westbound bridge entrance approach slab (Control)

(5.5' depth @ 20:1) Select Backfill = 474.8 CY x $12/CY	$ 5,697.60
Underdrain Pipe - PVC Perforated - 4in = 68 LF x $14/LF	$ 952.00
Underdrain Pipe - PVC Non-perforated - 4in = 47.5 LF x $14/LF	$ 665.00
Total	$ 7,314.60

Five Years and Final Evaluation

The test and control sections were visited on 11/23/99, 12/06/00, 11/15/01, 11/20/02, and 10/03/03. The asphalt roadway was chip sealed in 1999. This chip seal added a little height to the roadway and made the slight bump where the asphalt meets the approach slab more severe.

During the summer of 2000, a contract project to mill bumps at bridges included this experimental section. The milling improved the general overall ride but did not completely remove the bump. Photo 9 shows that in the cold winter months a 1 inch gap opens up between the asphalt and approach slabs. A tape measure can be inserted to a depth ranging from 6 to 12 inches.

Photo 9 – Winter 1999 gap opening of 1 inch between asphalt and approach slab in the Control Section WB.

Photo's 10, 11, and 12 from years 1999 and 2000 show conditions that existed including bumps, gaps, and sealant failure.

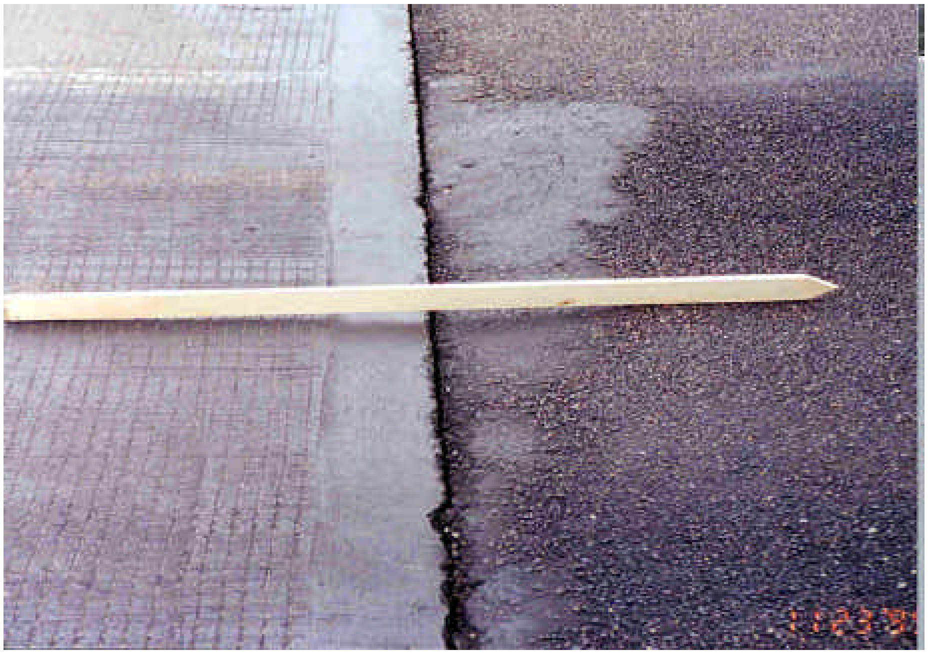


Photo 10 – Experimental Section 1999 EB - asphalt to approach slab - dip.

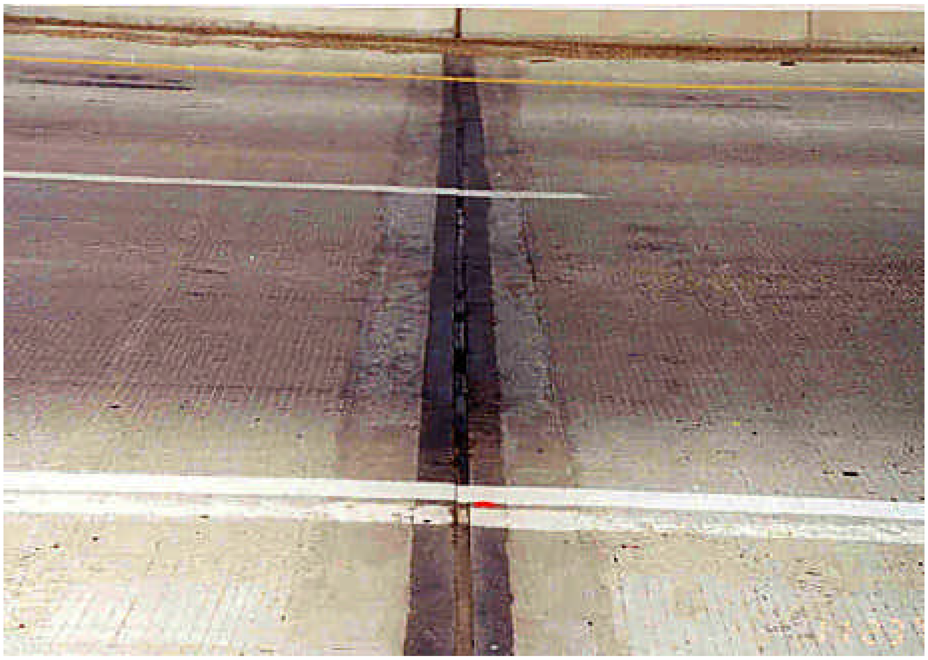


Photo 11 - Seal failure - EB adhesion loss and punched down 1999.

This bump in the eastbound experimental section where the asphalt meets the approach slab has been getting worse each year. Photo's 12 and 13 were taken in November of 2001. The approach slab receives a dynamic load each time a loaded truck hits it at highway speeds. This puts a lot of stress on the approach slab.

Photo 12 – Shows drop from asphalt to approach slab in the outside wheelpath of the experimental section of approximately ¾ inch.

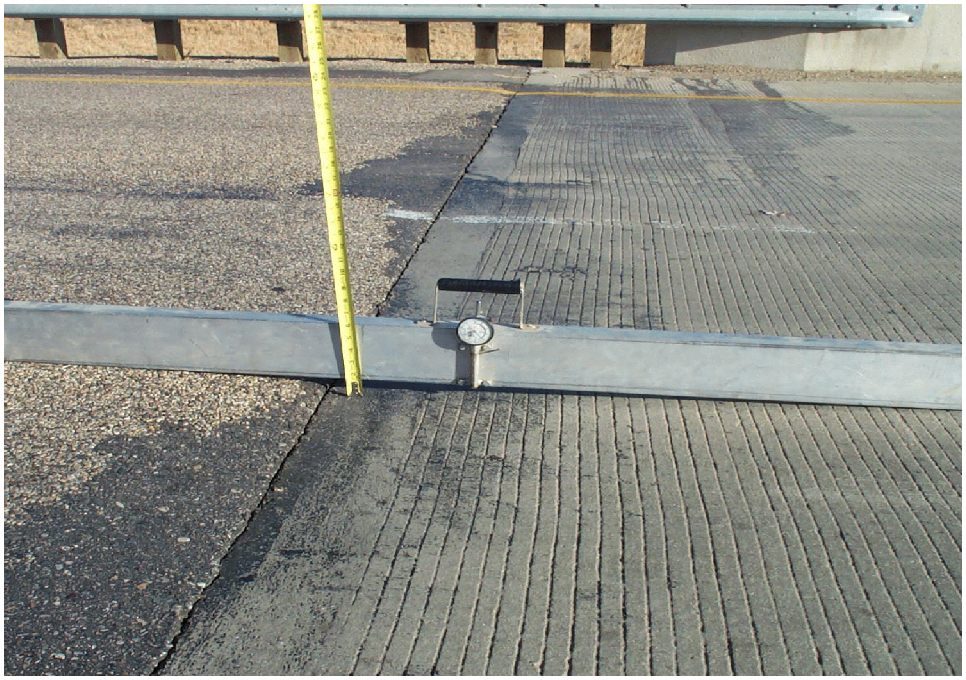


Photo 13 – Between wheel paths of driving lane – 1 ½" drop from asphalt to approach slab.

The approach slabs are settling as shown in photos 14 and 15. This measurement is taken at the end of the wing wall which is 14 feet from the abutment wall or 4 feet from the beginning of the approach slab.

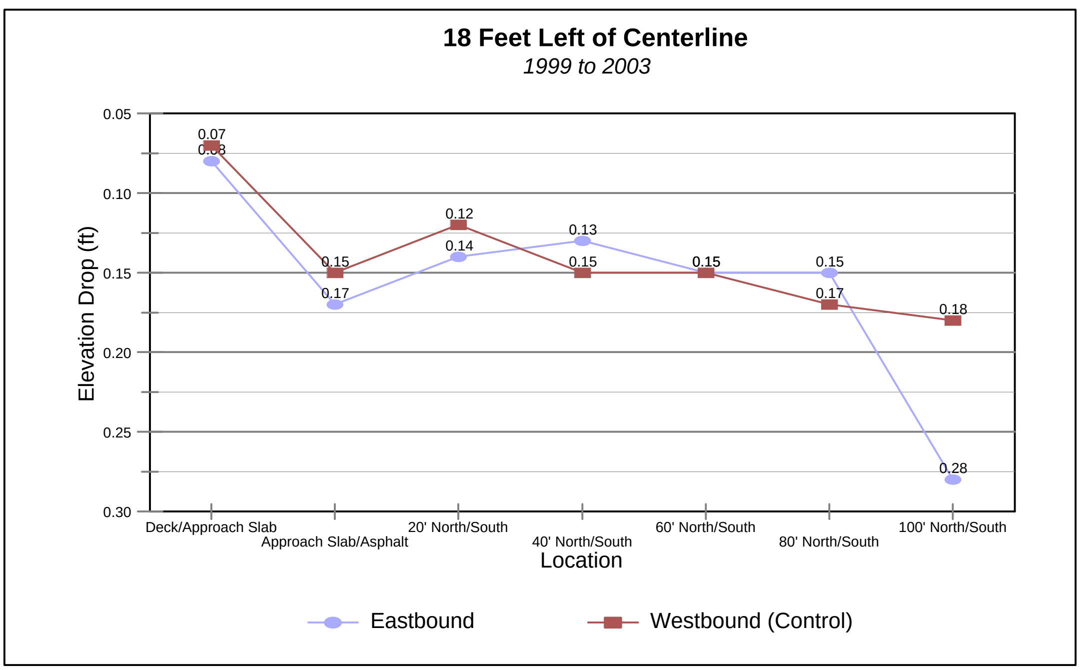
Photo 14 – 1 3/8" drop from wingwall to approach slab. Experimental section Rt.

Photo 15 – Experimental section Lt. Side – or Passing lane side, the guard rail bolts show stressing at the wingwall due to settling of the approach slab.

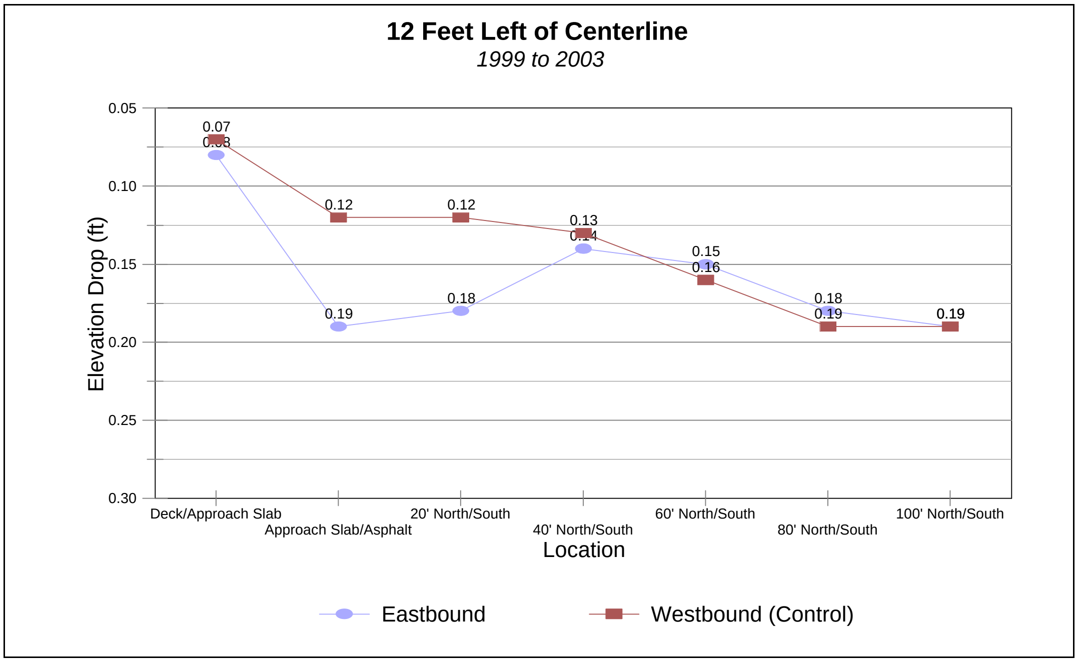
An elevation survey was conducted in 1998 on the test section (EB) beginning at the bridge and continuing 100 feet back into the asphalt pavement.

The control section (WB) was included in the elevation survey in 1999. The difference in elevation at each location was determined from 1999 to 2003 data. The elevation data is located in Appendix C. These changes in elevation are shown in the following graphs. Notice that the drop in elevation in the eastbound roadway or experimental section is slightly less than the drop in the control section. The data averaged for years 1999, 2000, and 2001 show a decrease in elevation of 2.5” for the control and 1.6” for the experimental section. The average elevation decrease figured for 2002 and 2003 was 1.6” for the control and 3” for the experimental section.

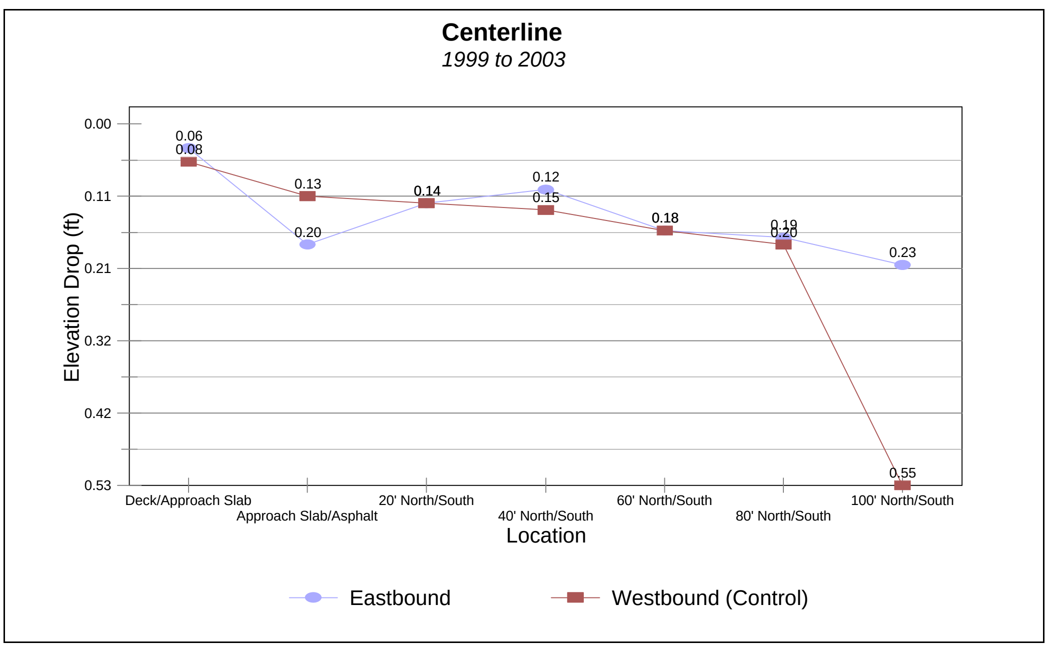
Elevations are measured at five points across the roadway, 18 feet left of centerline, 12 feet left of centerline, centerline, 12 feet right of centerline, and 22 feet right of centerline. These five points have been graphed and are shown as follows. Overall, the experimental section has not prevented the bump from occurring at the end of the approach slab. The graphs show about a 1% difference in elevation drop between the experimental section and the control section. This was the difference as of June 2003. It must be pointed out that these elevation differences between the control and experimental sections keep changing due to maintenance patching to smooth the ride.



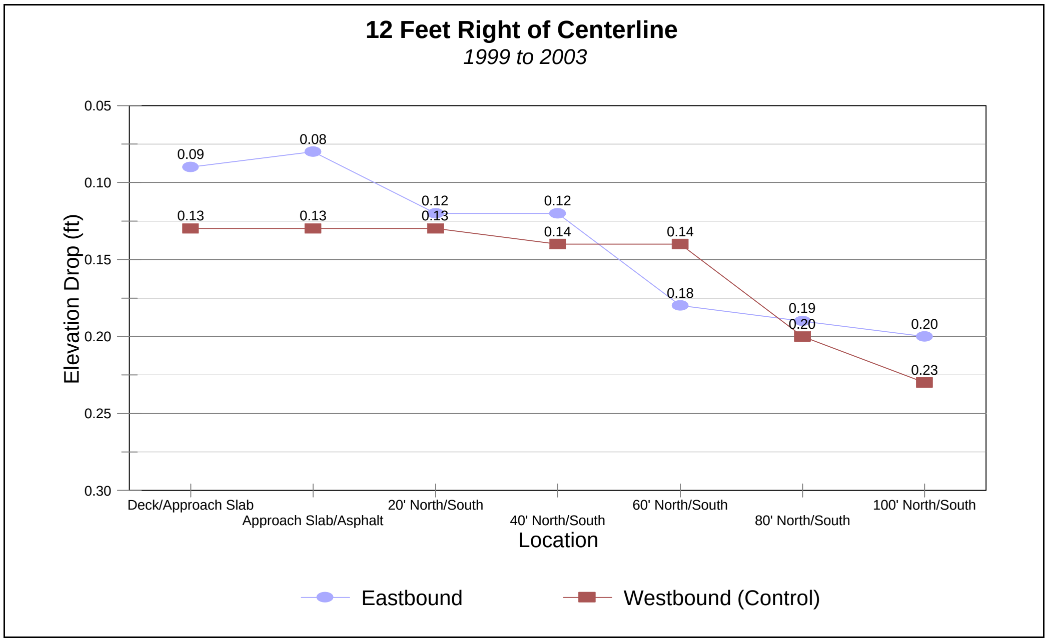
Graph 1



Graph 2



Graph 3



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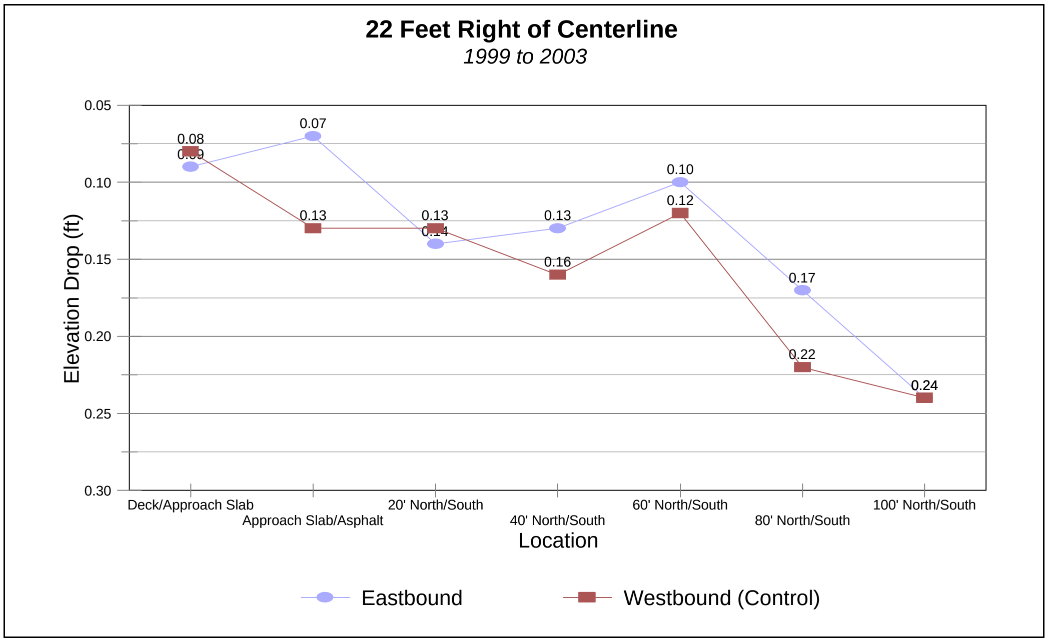


Graph 5

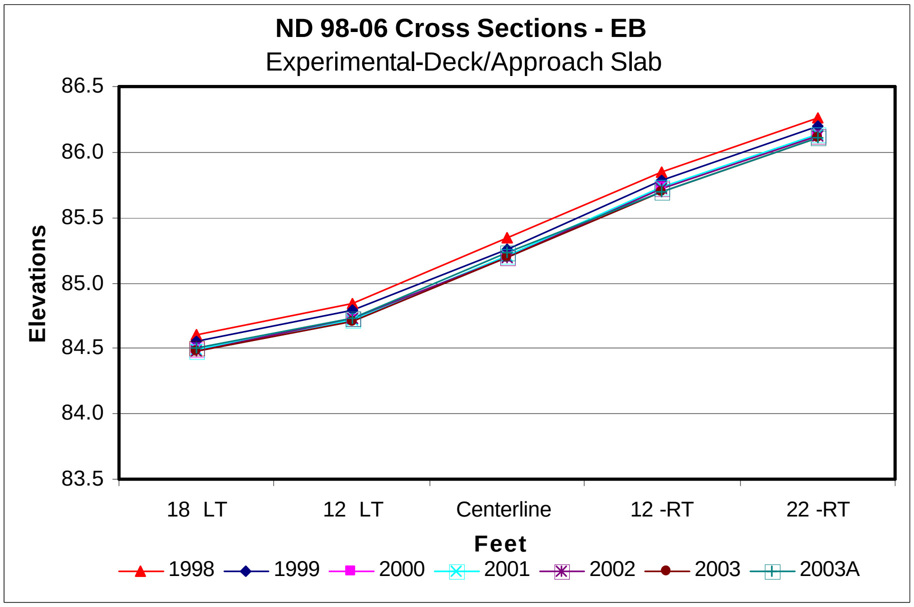
Elevations for the control section were not collected in 1998. The graphs show that both sections, the experimental section and the control section, was consolidating up to the year 2000. The eastbound experimental section at all 5 points shows very little change in elevation from 2000 to 2001 except at the approach slab/asphalt contact. The control section is still showing consolidation at all 5 points.

In the experimental section, eastbound bridge, the asphalt is slightly higher than the concrete approach slab. This sudden change in elevation causes dynamic impacts by heavy vehicles and may be part of the reason it is still consolidating in 2001.

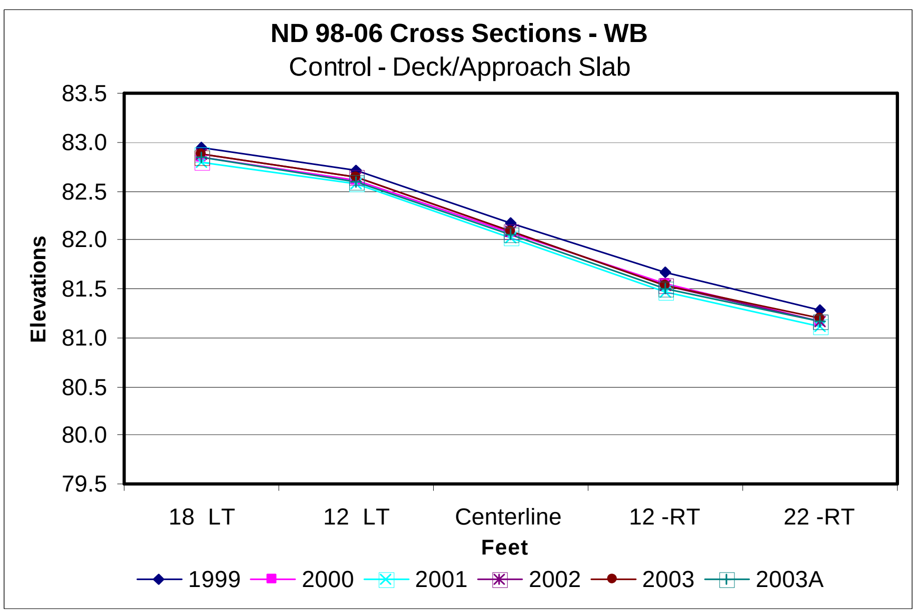
Mud Jacking Approach Slabs

The experimental feature to build a better foundation under the approach slab that would prevent the bump at the approach slab/asphalt pavement interface, has not been successful. The NDDOT thus included this experimental project in a contract to repair bridges and box culverts in 2003. The work included lifting the north and south approach slabs of the twin structures. The mud jacking was to lift the slabs to their original positions.

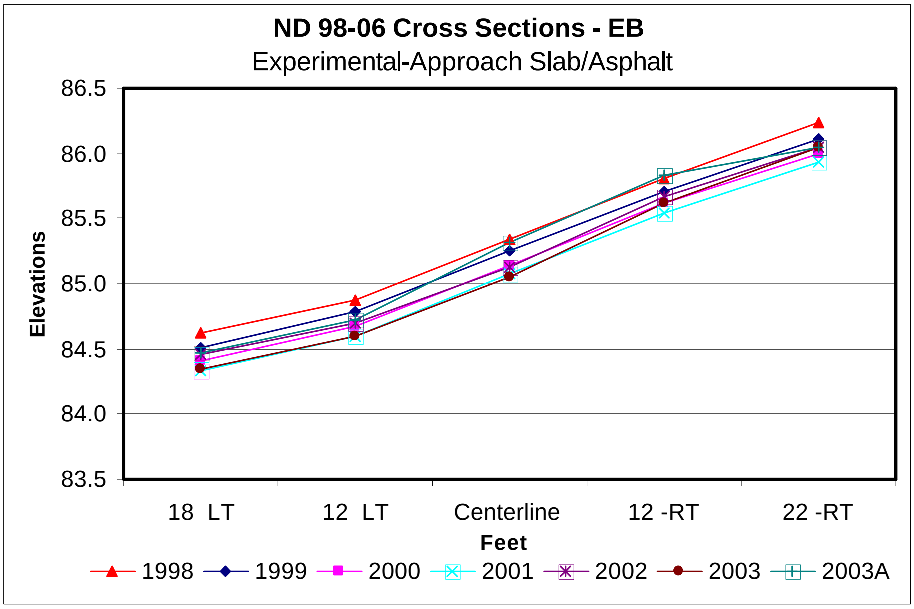
The 5 cross-section points of each section were plotted for comparison in graphs 6 through 19. The data representing 2003 is before mud-jacking and 2003A is after mud-jacking.



Graph 6



Graph 7



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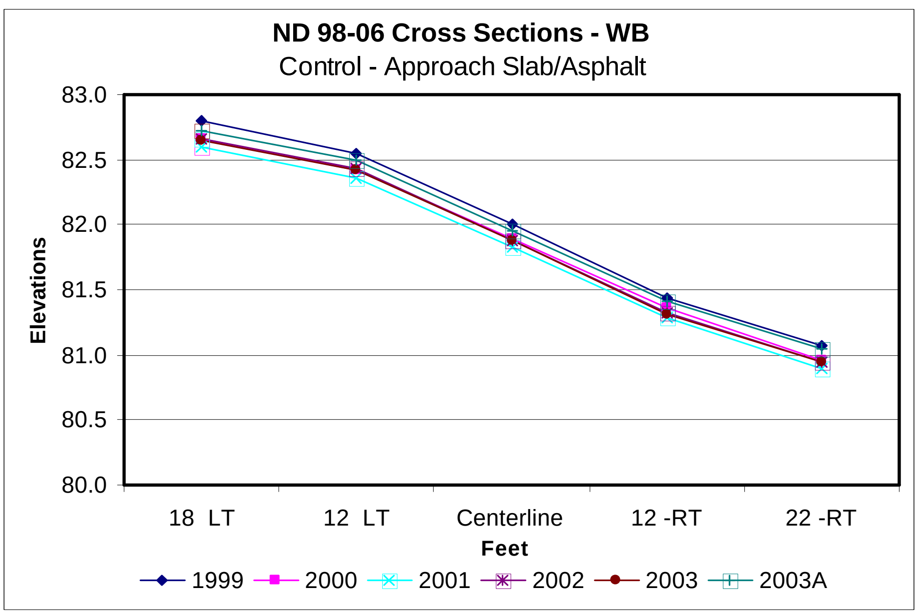
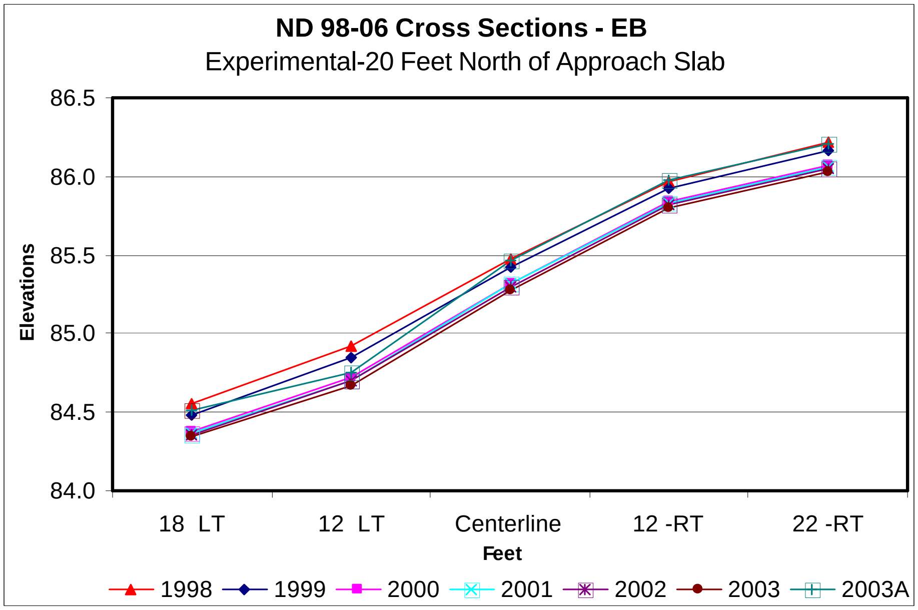
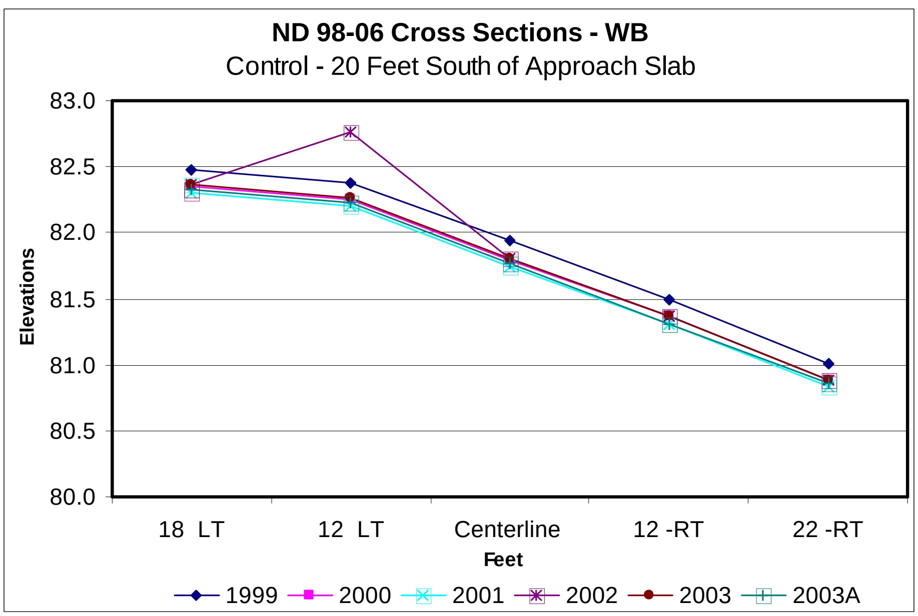


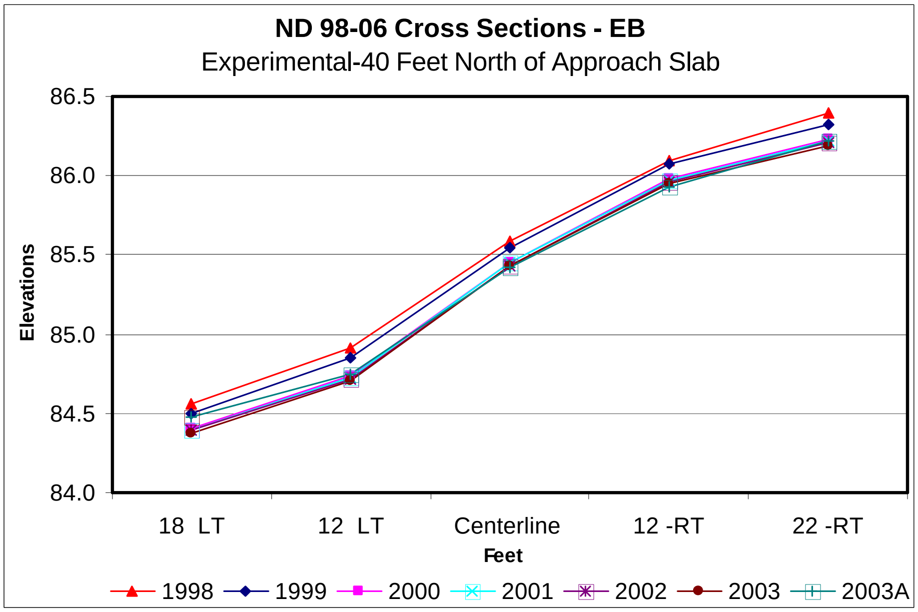
Graph 9



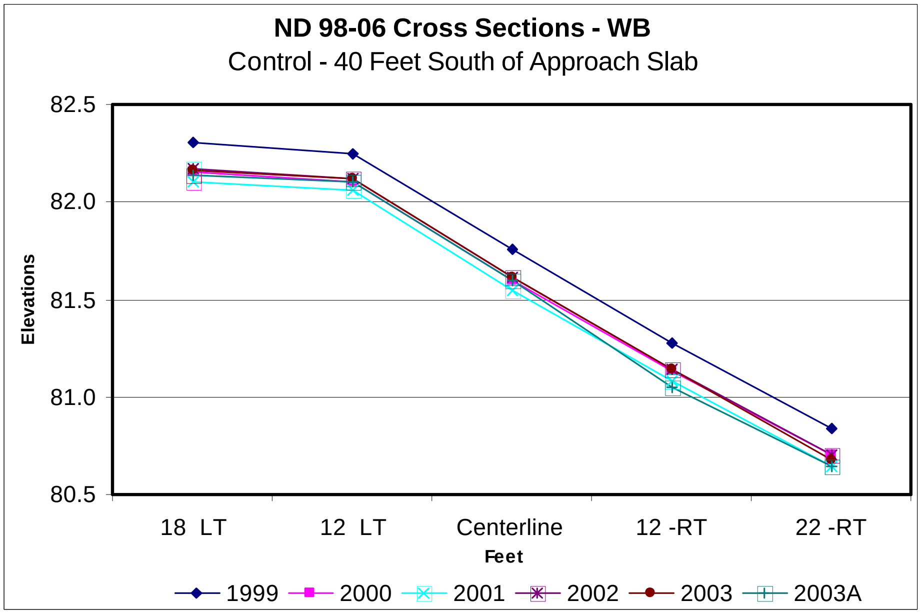
Graph 10



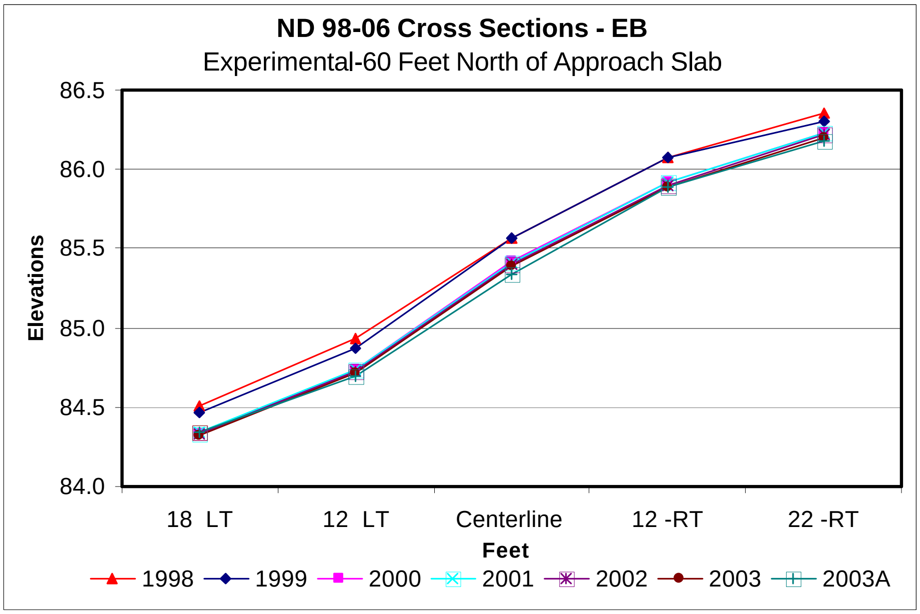
Graph 11



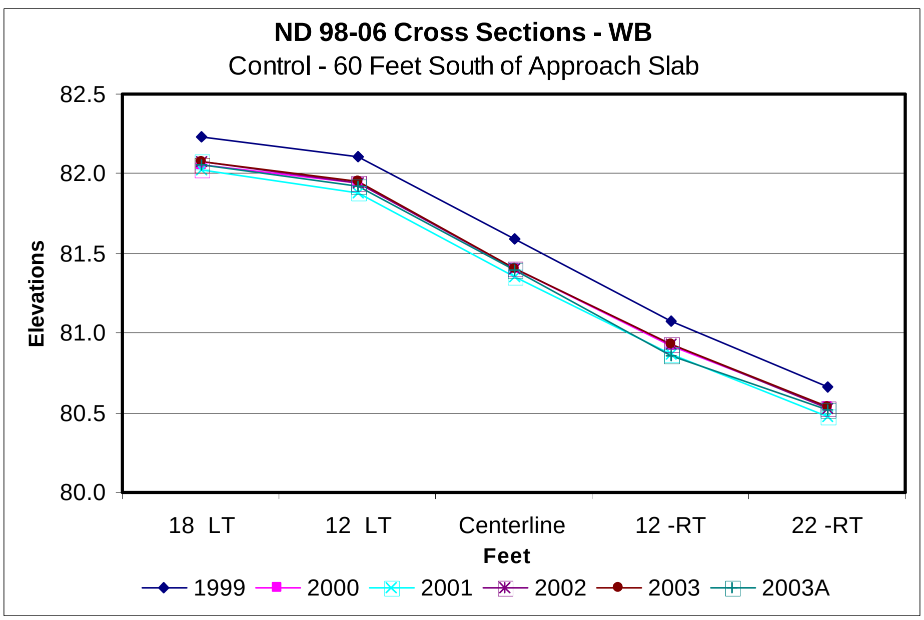
Graph 12



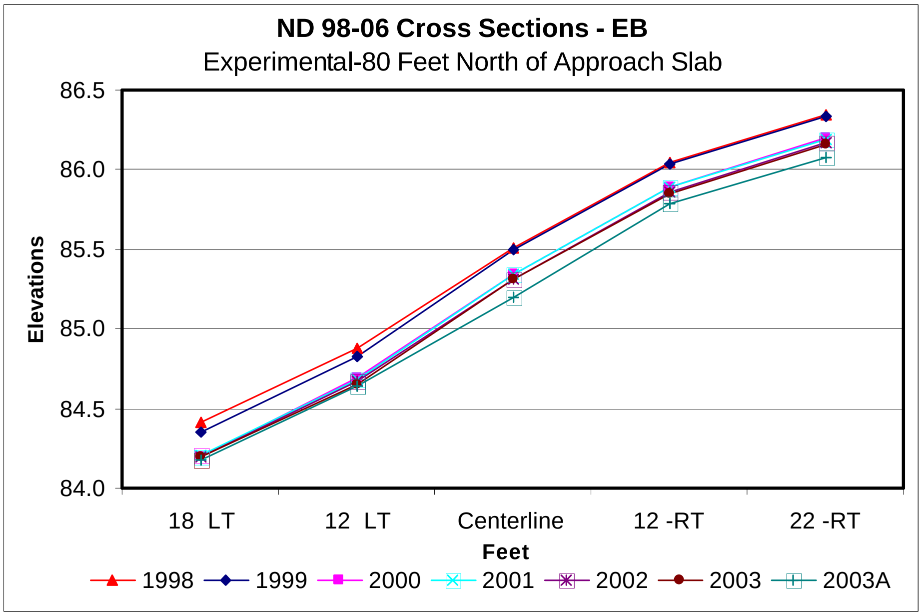
Graph 13



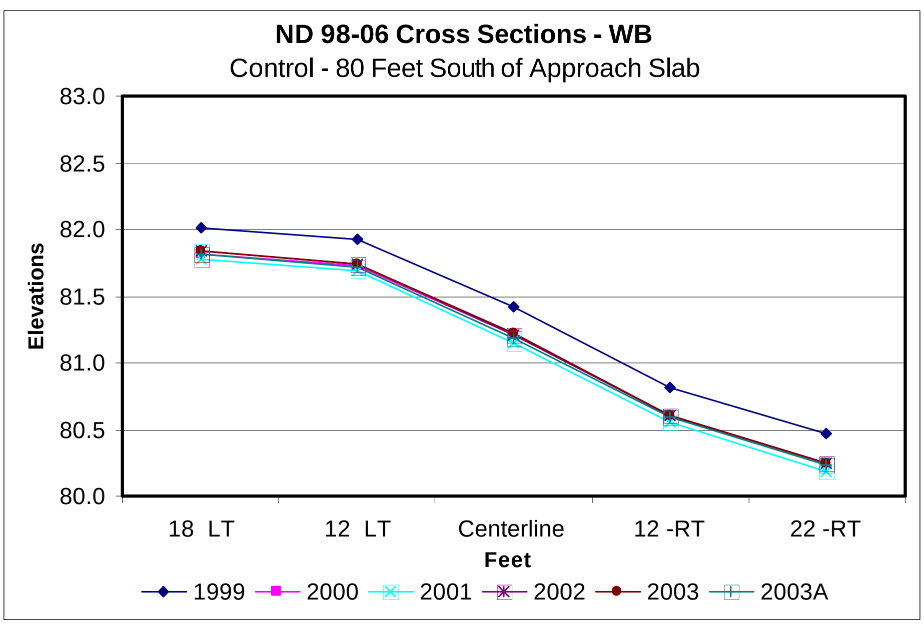
Graph 14



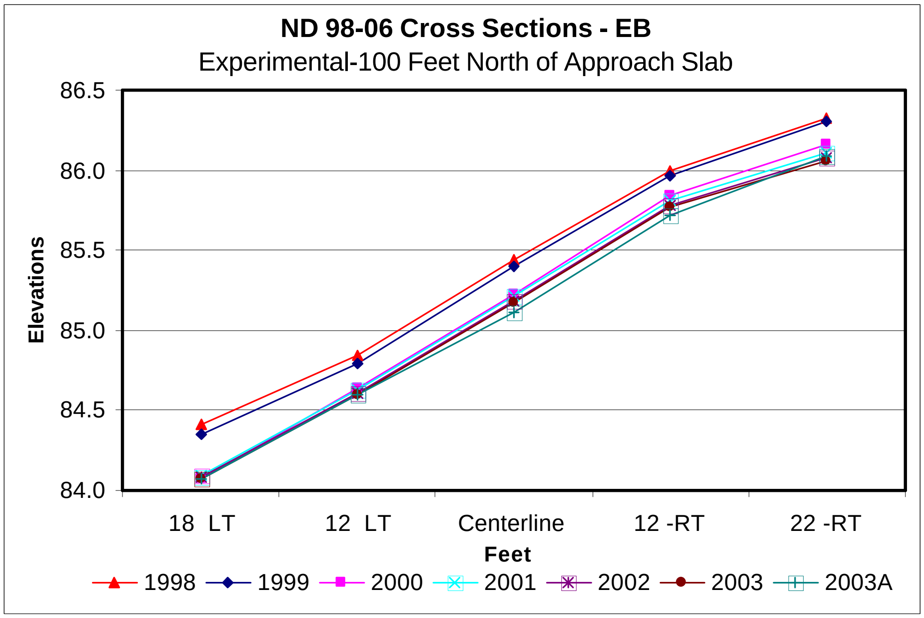
Graph 15



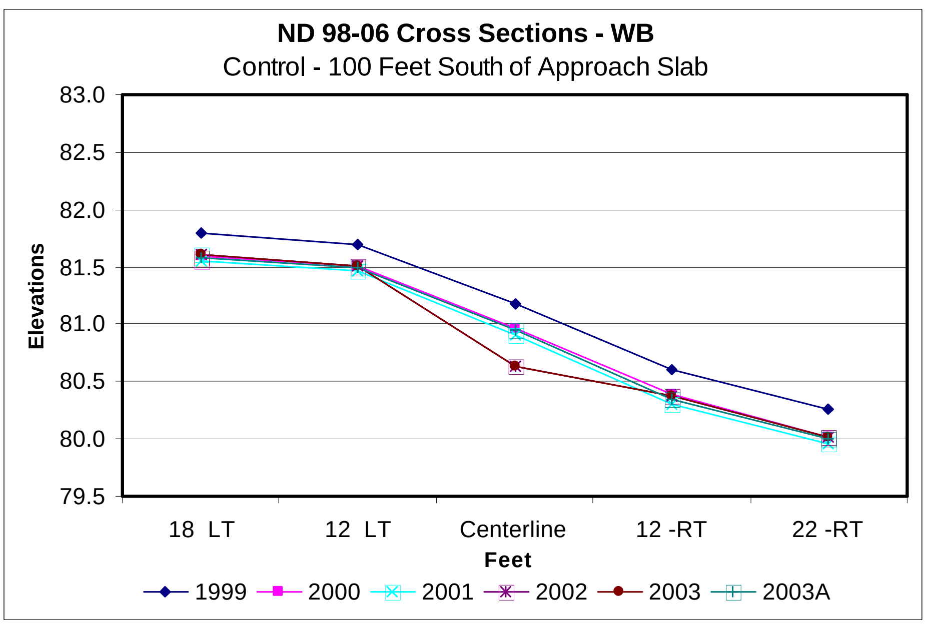
Graph 16



Graph 17



Graph 18



Graph 19

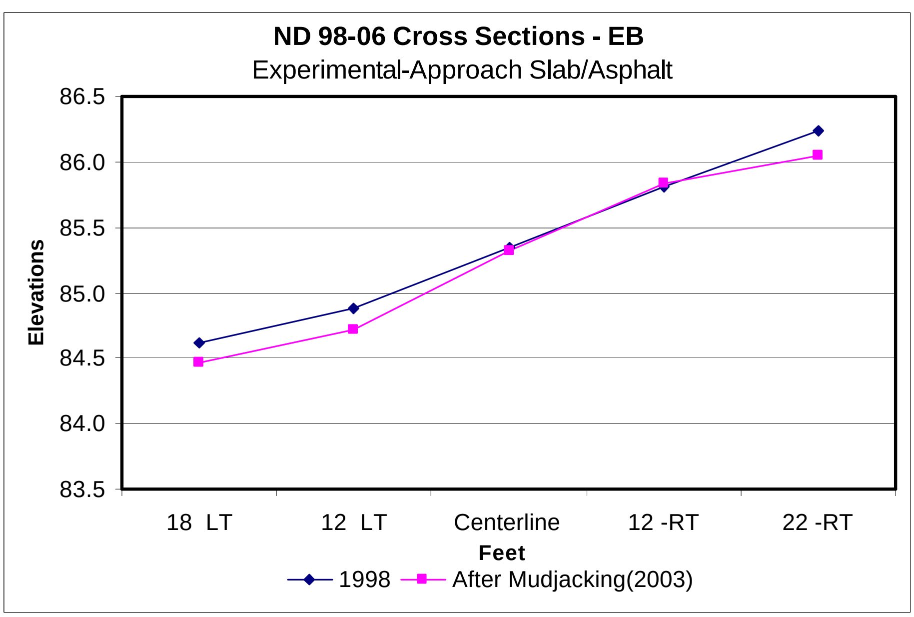
Summary

Spreading and compacting asphalt so it is level with the concrete approach slab is difficult. In this case, the asphalt after construction was slightly higher than the approach slab. The performance evaluation is based on the decrease in elevation over time.

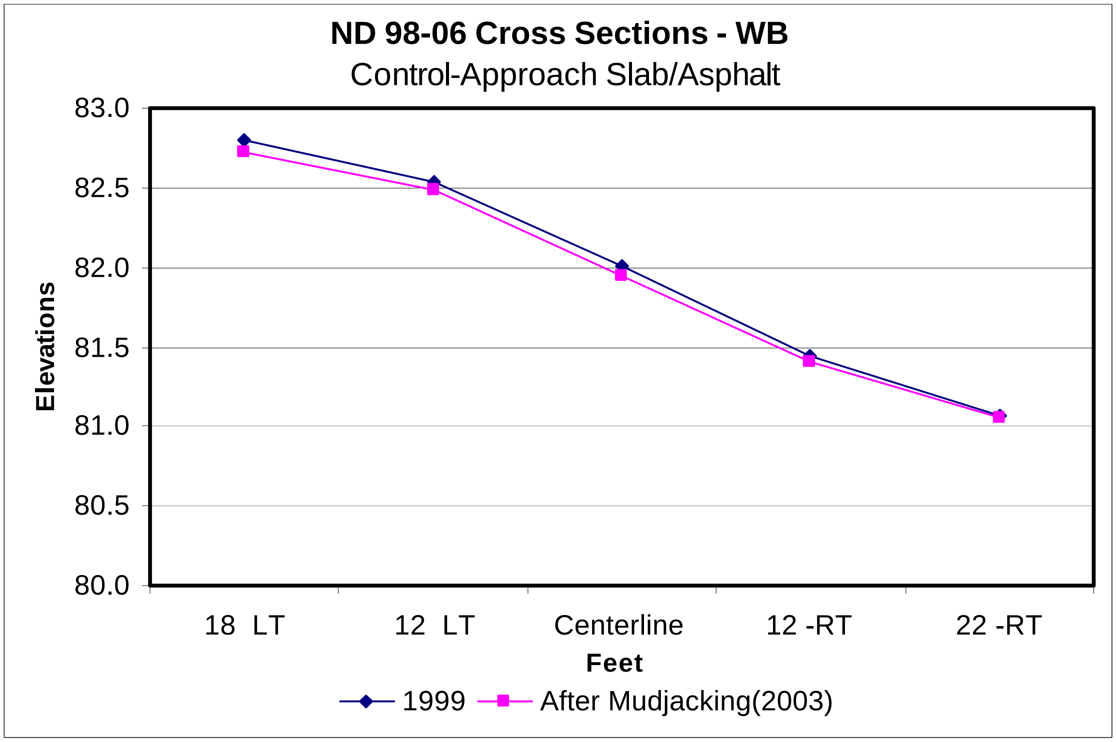
The cross-section graphs show that roadway consolidation is still taking place in the control section; whereas the experimental section has stopped consolidating with exception to one location. The existing bump or dip in the experimental section at the approach slab/asphalt contact results in the application of dynamic load to the concrete approach slab by heavy vehicles. This dynamic loading may be contributing to the settlement at this interface.

The data averaged from the evaluation surveys conducted in 1999, 2000, and 2001 indicate that the average decrease in elevation was 2.5” for the control and 1.6” for the experimental section. The 2002 and 2003 evaluations show a decrease in elevation from the original to be 1.6" for the control section and 3" for the experimental section.

This experimental feature to build a better foundation under the approach slab that would prevent the bump at the interface of the approach slab and asphalt pavement, was not successful. The mud jacking of the approach slabs restored the slabs near their original elevations. Graphs 20 and 21 show the original approach slab elevations near the asphalt pavement interface for both eastbound and westbound bridges.



Graph 20



Graph 21

Recommendation

It is questionable whether the method used on this bridge project of constructing a bridge approach slab and embankment is the appropriate method to use to try and prevent the bump at the interface of the approach slab and embankment.

It is recommended that whatever method is selected for constructing the embankment behind the abutment wall, that emphasis be placed on compaction. Compaction seems to be the leading component attributing to the bump at the approach slab and roadway interface.

A better approach may be to wait a few years to construct the approach slab in order to allow time for settlement or equalization of embankment pressures.

Good planning and close attention to construction of the interface between the roadway and approach slab will better ensure a smooth transition.

Appendix A

DESIGN DATA				
Traffic	Average Daily			Est.Max.Hr.
Current 1995	Pass. 3200	Trucks 400	Total 3600	360
Forecast 2015	Pass. 4160	Trucks 520	Total 4680	468
Minimum Sight Dist for		Design Speed 70		
Stopping 625		Bridges HS-25		
Safe Passing				
Passing for Marking				

JOB# 6

FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	NH-4-002(051)138	1

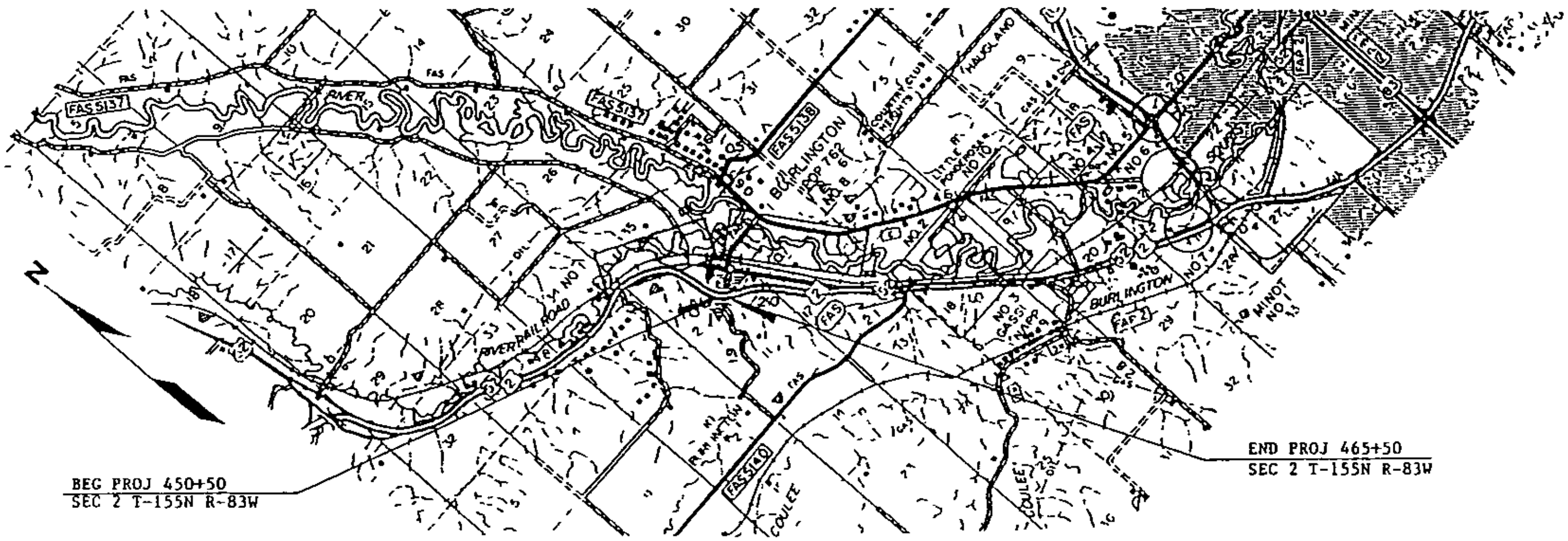
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

FEDERAL AID PROJECT
PROJECT NO NH-4-002(051)138
IN WARD COUNTY
STRUCTURAL, GRADING, SURFACING & INCIDENTIAL

GOVERNING SPECIFICATIONS.

Standard Specifications adopted by the North Dakota Department of Transportation October 1997 Standard Drawings currently in effect and other Contract Provisions submitted herein

LENGTH OF PROJECT
0 284



PAVING SECTION	
URBAN SECTION	
TRAFFIC SECTION	
RURAL SECTION	
RECOMMEND APPROVAL	8-21, 1997
DESIGN ENGINEER	

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED

DIVISION ADMINISTRATOR DATE

APPROVED DATE 8-21-97

DIRECTOR OF HIGHWAYS AND ENGINEERING
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

RAY ZINK
REGISTERED PROFESSIONAL ENGINEER
P.E. 972
NORTH DAKOTA

ESTIMATE OF QUANTITIES

FHWA REGION	STATE	FED AID PROJ NO	SHEET NO
8	N D	NH-4-002(051)138	6

SPEC	CODE	ITEM DESCRIPTION	UNIT	NH-4-002 051)138	TOTAL
103	0100	CONTRACT BOND	L SUM	1	1
201	0330	CLEARING & GRUBBING	L SUM	1	1
202	0105	REMOVAL OF STRUCTURE	L SUM	1	1
202	0132	REMOVAL OF BITUMINOUS SURFACING	SY	11,333	11,333
202	0170	REMOVAL OF CULVERTS-ALL TYPES & SIZES	LF	168	168
203	0101	COMMON EXCAVATION-TYPE A	CY	3,149	3,149
203	0109	TOPSOIL	CY	2,480	2,480
203	0113	COMMON EXCAVATION-WASTE	CY	58 956	58,956
210	0101	CLASS I EXCAVATION	L SUM	1	1
210	0198	SELECT BACKFILL	TON	966	966
210	0201	FOUNDATION PREPARATION	EA	2	2
216	0100	WATER	M GAL	336	336
302	0120	AGGREGATE BASE COURSE CL 5	TON	15,213	15,213
401	0100	MC70 OR 250 LIQUID ASPHALT	GAL	4 823	4,823
401	0152	SS1H OR CSS1H EMULSIFIED ASPHALT	GAL	2 590	2 590
408	0185	HOT BITUMINOUS PAVEMENT CL 29	TON	5,282	5 282
408	0320	120-150 ASPHALT CEMENT	TON	284	284
408	9605	CORED SAMPLE-BITUMINOUS PAVEMENT	EA	20	20
420	0160	BLOTTER MATERIAL CL 44	TON	55	55
550	0215	CONCRETE BRIDGE APPROACH SLAB	SY	383 4	383 4
602	0130	CLASS AAE-3 CONCRETE	CY	748 6	748 6
602	1130	CLASS AE-3 CONCRETE	CY	675 2	675 2
602	1250	PENETRATING WATER REPELLENT TREATMENT	SY	2,116	2,116
604	9960	PRESTRESSED I-BEAM-54IN M	LF	1,864	1,864
612	0115	REINFORCING STEEL-GRADE 60	LBS	189,582	189,582
612	0116	REINFORCING STEEL-GRADE 60-EPOXY COATED	LBS	79 494	79,494
622	0016	STEEL H-PILE TIPS 14 X 73	EA	112	112
622	0060	STEEL PILING HP 14 X 73	LF	7,830	7,830
622	1900	STEEL TEST PILING HP 14 X 73	LF	594	594
622	7000	DYNAMIC TESTING COMPONENTS	L SUM	1	1
622	7001	DYNAMIC PILE TEST	EA	8	8
702	0100	MOBILIZATION	L SUM	1	1
704	0100	FLAGGING	MHR	750	750

A-2

ESTIMATE NUMBER 149 RUN DATE 09/26/1997 TIME 12 47 45

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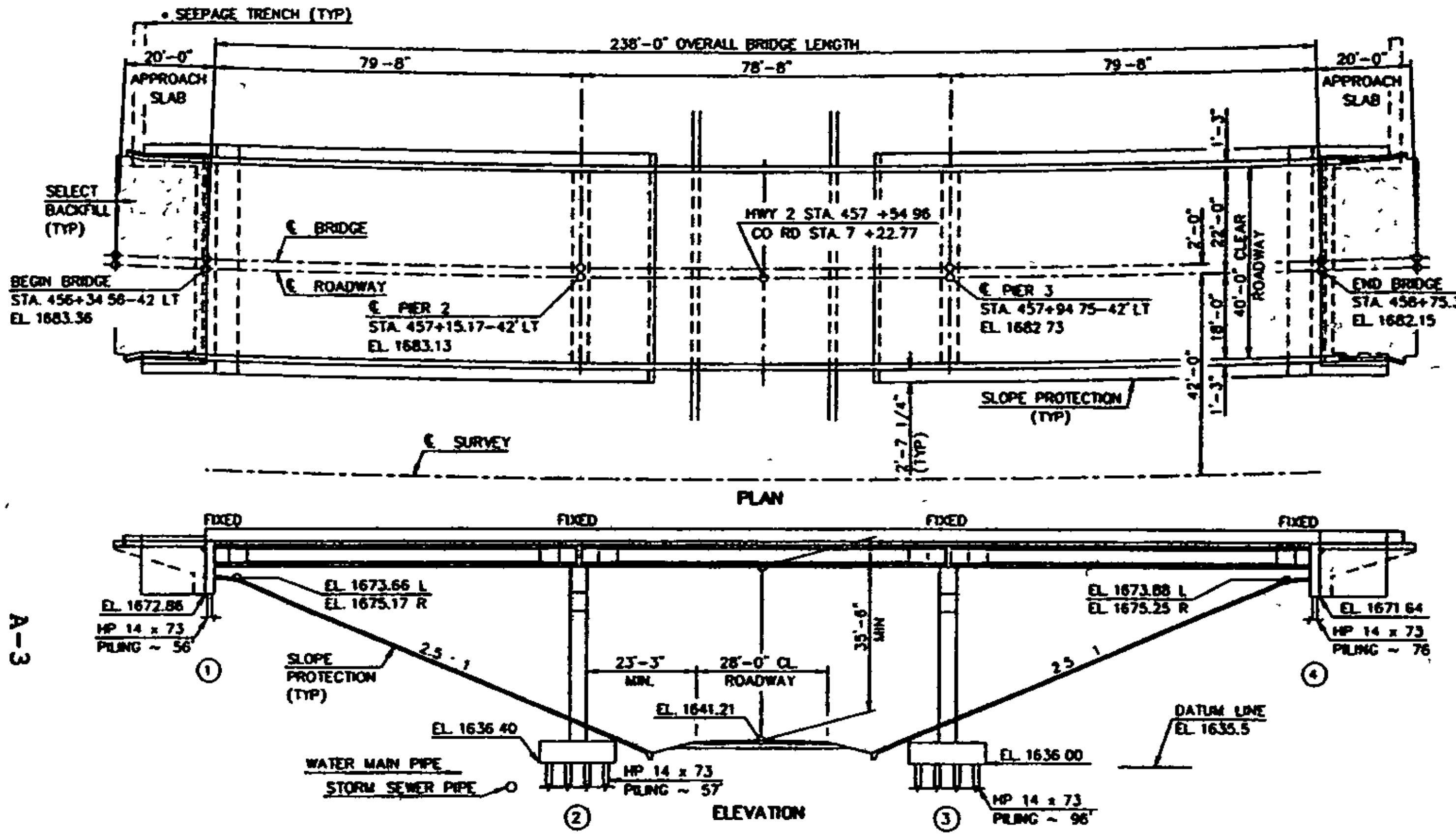
BRIDGE CODE	FHWA REGION	STATE	FEDERAL AID PROJECT NUMBER	SHEET NO.
X-281	8	ND	NH-4-002(051)138	15



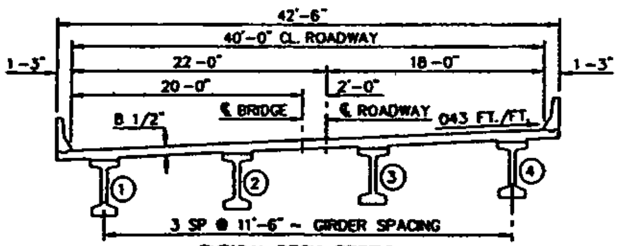
• SEEPAGE TRENCH ~ SEE DETAILS ~ DWGS. 2-138.353L-6 & 7

DESIGN STRENGTHS.

f'c = 3,000 PSI ~ CLASS AE-3 CONCRETE
f'c = 4,000 PSI ~ CLASS AAE-3 CONCRETE
f'c = 5,500 PSI ~ PRESTR. CONC GIRDER
fy = 60,000 PSI ~ REINFORCING STEEL

LOAD FACTOR DESIGN

A-3



TYPICAL DECK SECTION

SPEC	CODE	ITEM DESCRIPTION	UNIT	QUANTITY
202	0105	REMOVAL OF STRUCTURE	L SUM	5
210	0101	CLASS 1 EXCAVATION	L SUM	5
210	0198	SELECT BACKFILL	TON	482
210	0201	FOUNDATION PREPARATION	EA.	1
550	0215	CONCRETE BRIDGE APPROACH SLAB	SQ. YD	191.7
602	0130	CLASS AAE-3 CONCRETE	CU. YD	374.3
602	1130	CLASS AE-3 CONCRETE	CU YD.	337.6
602	1250	PENETRATING WATER REPELLENT TR.	SQ. YD	1056
604	9960	PRESTRESSED I-BEAM 54" M	L FT	932
612	0115	REINFORCING STEEL GRADE 60	LBS.	94,791
612	0116	REINFORCING STEEL GRADE 60 EPOXY COATED	LBS.	39,747
622	0016	STEEL H-PILE TIPS 14 x 73	EA.	56
622	0060	STEEL PILING HP 14 x 73	L FT	3831
622	1900	STEEL TEST PILING HP 14 x 73	L FT	285
622	7000	DYNAMIC TESTING COMPONENTS	L SUM	.5
622	7001	DYNAMIC PILE TEST	EA.	4
708	1100	SLOPE PROTECTION, CONCRETE	SQ. YD.	1088
714	9720	UNDERDRAIN PIPE PVC PERFORATED 4 IN.	L FT	136
714	9770	UNDERDRAIN PIPE PVC NONPERFORATED 4 IN.	L FT	56
930	3000	BRIDGE BENCH MARKS	SET	5
930	8640	NOSING CONCRETE	L FT	80

BENCH MARKS

NO.	DESCRIPTION	LOCATION	ELEVATION
1	R.R. SPIKE	STA. 453 +00 ~ 60' LT.	1680.63
2	R.R. SPIKE	STA. 457 +80 ~ 64' LT	1681.46

STEVEN J MILLER REGISTERED PROFESSIONAL ENGINEER 1360 NORTH DAKOTA

SPECIAL PROVISIONS

NO	NAME
SP-6(97)	DYNAMIC PILE TESTING

STANDARD DRAWINGS

D-900-1, D-708-1 D-622-1

F W S. 15 PSF

HS 25 DESIGN LOADING

NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

BURLINGTON SEPARATION
LEFT BRIDGE

BRIDGE LAYOUT
PROJECT NH-4-002(051)138
STATION 457 + 54.96
WARD COUNTY

9/2/97 Steven J Miller
DATE BRIDGE ENGINEER

RVBRLO 97DLS41 JDS

2-138.353L

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FHWA REGION	STATE	FED AID PROJ NO.	SHEET NO.
8	N D	NH-4-002(051)138	16

BURLINGTON SEPARATION

100 SCOPE OF WORK This project consists of building two new 3-span concrete girder bridges Both bridges are 238' long with clear roadway widths of 40'

100 GENERAL The cost of furnishing and placing preformed expansion joint filler, concrete inserts, tie wire, bar spacers, bar supports, and other miscellaneous items shall be included in the price bid for Class AE-3 and AAE-3 concrete

202 REMOVAL OF STRUCTURE· The existing structure is a 33'-0" x 22'-5" x 356' S P P with timber struts in the middle 144' of the pipe There is a concrete headwall on each end of the S P P There is some fill dirt placed in the bottom of the S P P with an asphalt driving surface. The timbers shall be salvaged and remain the property of the NDDOT The timbers shall be neatly cut at the joints, removed, and transported to the Minot District yard of the NDDOT All other materials removed shall become the property of the contractor and shall be disposed of properly off of the right-of-way

210 EXCAVATION Class 1 excavation, at the abutments, shall extend from the bottom of the footing to the upper limits as shown on the Detail at Abutment drawing

210 EXCAVATION The excavation at the abutments, as shown, and the excavation required to build the piers shall be included in the lump sum bid item, "Class 1 Excavation "

210 SELECT BACKFILL Select backfill shall meet the requirements of Section 816 03, Class 3 The backfill shall be placed in layers of not more than 6 inches, moistened or dried as required, and thoroughly compacted with mechanical tamping equipment

550 BRIDGE APPROACH SLABS Mechanical finishing of the approach slabs shall be required A mechanical or hand-held transverse metal tine finish shall be applied Tining shall start 6" from the beginning and end of the approach slabs A surface tolerance of 3/16" in 10 feet is also required

602 DIAPHRAGMS The diaphragm concrete shall be placed before the deck concrete, the concrete shall cure for at least 72 hours before deck placement

602 SURFACE FINISH "D". Surface Finish "D" shall be required for the inside and top surfaces of the barrier

602 DECK CONCRETE Beams and girders have slight variations in the anticipated camber To build the deck to the designated thickness will require slight adjustments in deck elevation and/or riser dimensions These adjustments result in minor concrete quantity discrepancies The contractor shall consider this quantity discrepancy when he bids the unit price for Class AAE-3 Concrete. The Department will pay plan quantity of Class AAE-3 Concrete.

602 Deflection of the deck shoring shall be computed using the total dead load plus the weight of the finishing machine The forming shall be adjusted properly to accommodate the deflection and thereby maintain the total slab thickness specified in the plans

602 PENETRATING WATER REPELLENT TREATMENT: Penetrating water repellent shall be applied to the driving surface of the concrete deck

602 BARRIERS· Barriers shall be constructed according to the provisions of Section 602 03 B.4 except that there shall be no expansion or deflection joints. Make 3/4" V-grooves in all faces of the barriers at each pier and at equal spaces between substructures at approximately 10-foot spacing

602 DECK TINING Tining shall begin 6 inches from the beginning and the end of the deck and 6 inches from each deck joint

612 REINFORCING STEEL Dimensions for bent bars are given out to out and to tangent intersections unless otherwise noted

612 The bar fabricator shall add a prefix to all bar designations to differentiate between the different structures on this project

612 All reinforcing steel shall be Grade 60

622 PILING Piling shall be driven with a steam, air, or diesel hammer with a rated energy and ram weight not less than 44,406 foot-pound-tons, as computed by the formula W(E-9,702)+ 915 E, where W is the weight of the ram in tons and E is the rated hammer energy In no case shall the ram weight be less than 2700 pounds. The required hammer is subject to change, based on the test pile results.

622 Caution shall be used during pile driving at pier 2 There is a storm sewer and water main in the vicinity of pier 2

BURLINGTON SEPARATION

622 Toothed cast steel pile tips (ASTM A148 steel) shall be required on all pile driven

622 The pile length shown on the plans is for bidding purposes only The difference between the final in-place quantity and the quantity estimated by the engineer, after the test pile has been driven, will be used to determine underrun or overrun payments

708 SLOPE PROTECTION· The concrete slope protection will be limited to the cast-in-place type shown on Standard D-708-1

SHOP DRAWINGS CAD-generated shop drawings may be submitted on 11-inch by 17-inch detail sheets The contractor shall submit the following shop drawings to the Construction office for approval

1 Prestressed I-girders

DESIGN STRENGTH	F'C	3,000 PSI	Cl. AE-3 Concrete
	F'C	4,000 PSI	Cl. AAE-3 Concrete
	FY	60,000 PSI	GR 60 Reinforcing Steel
	F'C	5,200 PSI	Prestressed Girder Concrete

930 NOSING CONCRETE The nosing concrete material shall be an elastomeric concrete or a polymeric concrete that will provide a durable edge that can withstand live-load traffic without chipping or spalling The nosing concrete material shall be Ceva Crete 95, manufactured by E-Poxy Industries Inc , Elastomeric Concrete, as manufactured by the D S Brown Company, Silspec 900, as manufactured by Construction Materials Inc , Elastomeric Concrete as manufactured by Harris Speciality Chemicals Inc , or an approved equal The nosing shall be mixed and installed according to the manufacturer's recommendations The cost for the equipment, materials, and labor to install the nosing concrete on each side of the joint shall be included in the lineal foot bid item "Nosing Concrete "

FHWA REGION	STATE	FEDERAL AID PROJECT NUMBER	SHEET NO
8	ND	NH-4-002(051)138	25

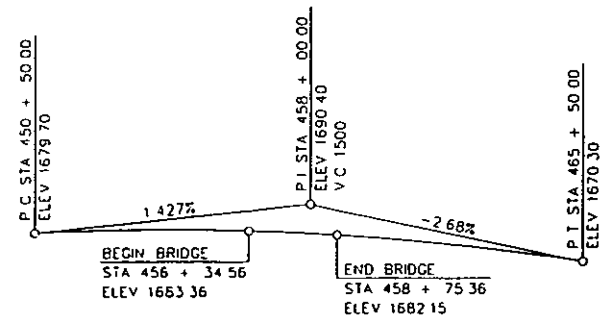
SCREED ELEVATIONS

℄ GIRDER 4	℄ GIRDER 3	℄ GIRDER 2	• ℄ GIRDER 1
1684 02	1683 53	1683 03	1682 54
1684 02	1683 52	1683 03	1682 54
03	53	04	54
03	54	04	55
03	54	04	55
02	52	03	54
1684 00	50	1683 01	52
1683 97	48	1682 99	49
94	44	95	46
90	40	91	41
85	35	1682 86	36
1683 79	1683 30	1682 81	1682 31
1683 79	1683 30	1682 80	1682 31
78	29	79	30
77	28	78	28
75	26	76	27
72	23	73	24
69	19	70	20
64	15	65	16
59	10	60	11
53	1683 04	54	1682 05
47	1682 97	48	1681 98
1683 40	1682 90	1682 40	1681 91
1683 39	1682 90	1682 40	1681 90
36	87	37	88
34	84	34	85
30	80	31	81
26	76	26	77
20	70	21	71
14	64	15	65
07	58	1682 08	58
1683 00	50	1682 00	50
1682 91	42	1681 92	42
1682 83	1682 33	1681 83	1681 33
1682 81	1682 32	1681 82	1681 32

1-6" BEGIN BRIDGE | 10 EQ SP = 77-8 END OF BEAM 1-0" END OF BEAM | 10 EQ SP = 77-6" END OF BEAM 1-0" END OF BEAM | 10 EQ SP = 77-6" END OF BEAM END OF BEAM | 1-6 END BRIDGE

• GIRDER NO 1 IS THE EAST GIRDER

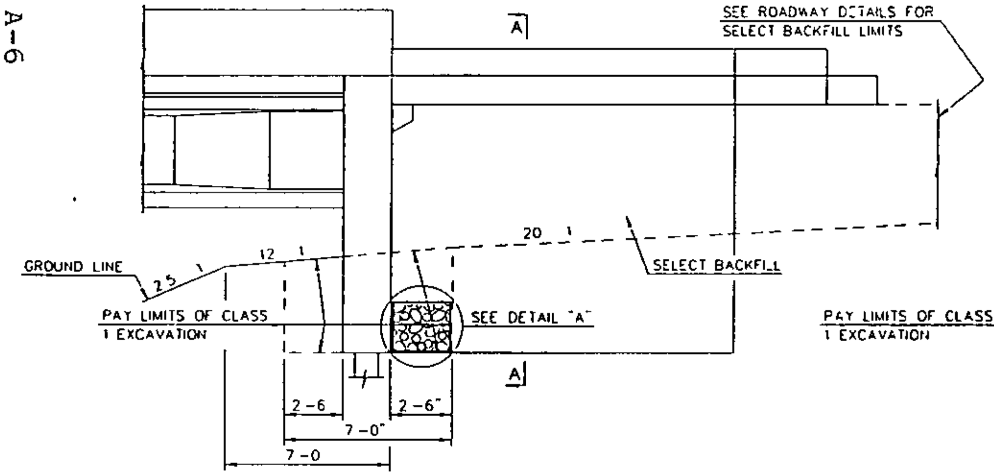
SCREED ELEVATIONS



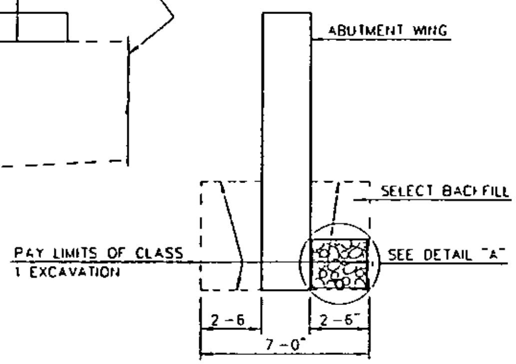
VERTICAL CURVE DATA

HORIZONTAL CURVE DATA

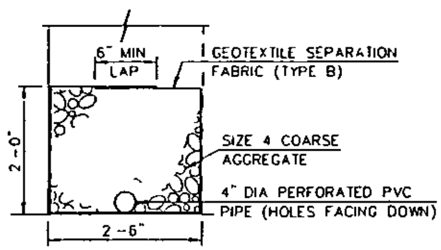
P I STA = 463 + 86 20
T S STA = 446 + 07 51
S C STA = 448 + 57 51
Δ = 49° 06 35" LT
D = 1° 35 2 – 250 SP
R = 3618 80
SC = 1° 58 45"
YC = 249 97
XC = 2 88
TS = 1778 69
L = 2851 77
SE = 0 043
C S STA = 477 + 09 28
S T STA = 479 + 59 28



DETAIL AT ABUTMENT



A-A



DETAIL "A"

BURLINGTON SEPARATION

SCREED ELEVATIONS
DETAIL AT ABUTMENT,
VERTICAL & HORIZONTAL
CURVE DATA

2-138 353L-6

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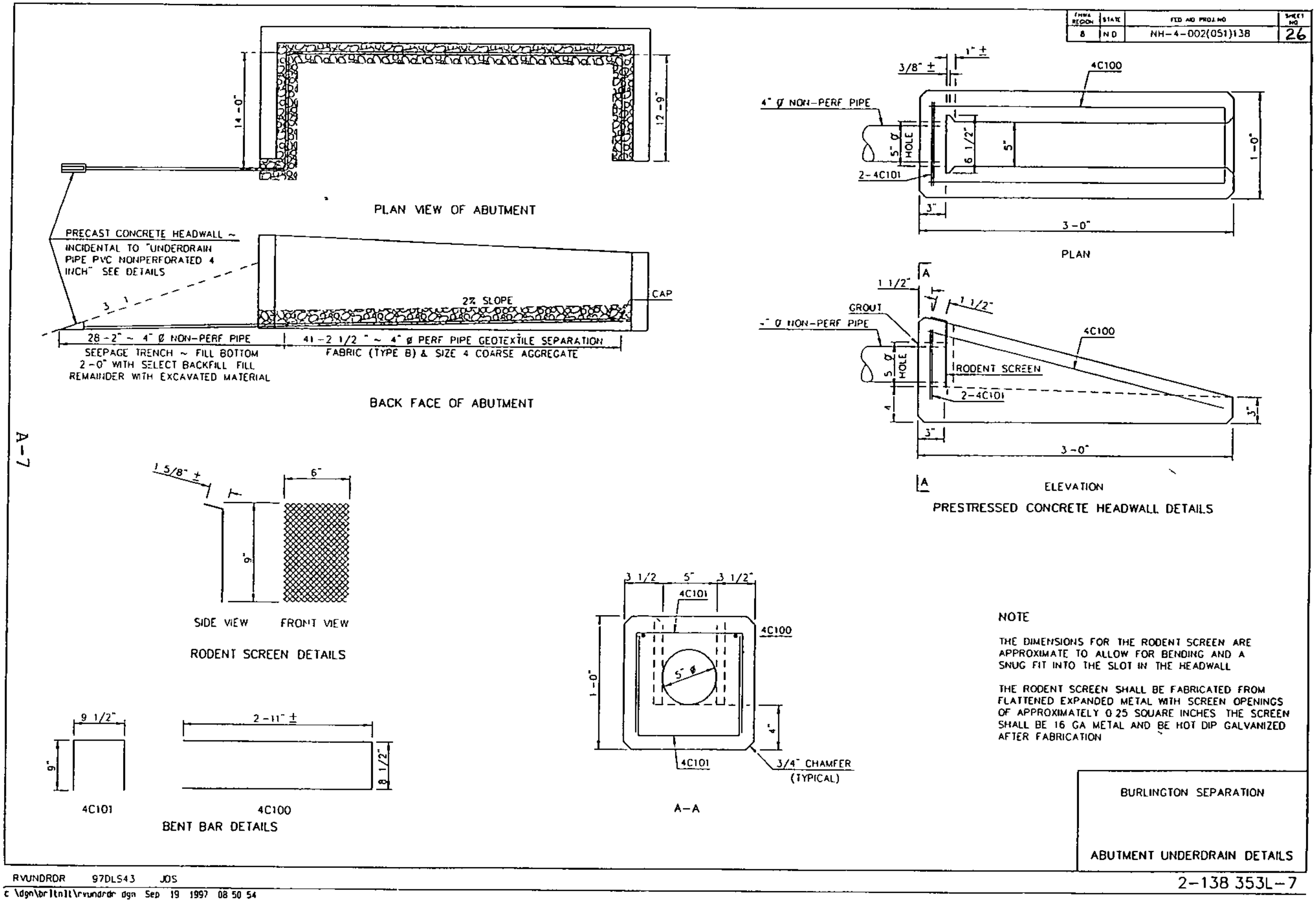
FHWA REGION 8 STATE N D FED AID PROJ NO NH-4-002(051)138 SHEET NO 26
PLAN VIEW OF ABUTMENT
14-0"
12-9"
PRECAST CONCRETE HEADWALL ~ INCIDENTAL TO "UNDERDRAIN PIPE PVC NONPERFORATED 4 INCH" SEE DETAILS
2% SLOPE
CAP
28-2" ~ 4" Ø NON-PERF PIPE
SEEPAGE TRENCH ~ FILL BOTTOM 2-0" WITH SELECT BACKFILL FILL REMAINDER WITH EXCAVATED MATERIAL
41-2 1/2" ~ 4" Ø PERF PIPE GEOTEXTILE SEPARATION FABRIC (TYPE B) & SIZE 4 COARSE AGGREGATE
BACK FACE OF ABUTMENT
4" Ø NON-PERF PIPE
3/8" ±
1" ±
4C100
5" Ø HOLE
6 1/2"
5"
2-4C101
3"
3-0"
1-0"
PLAN
1 1/2"
GROUT
1 1/2"
4C100
RODENT SCREEN
2-4C101
ELEVATION
PRESTRESSED CONCRETE HEADWALL DETAILS
1 5/8" ±
6"
9"
SIDE VIEW
FRONT VIEW
RODENT SCREEN DETAILS
3 1/2
5"
3 1/2"
4C101
4C100
5" Ø
3/4" CHAMFER (TYPICAL)
A-A
9 1/2"
2-11" ±
8 1/2"
4C101
4C100
BENT BAR DETAILS
NOTE
THE DIMENSIONS FOR THE RODENT SCREEN ARE APPROXIMATE TO ALLOW FOR BENDING AND A SNUG FIT INTO THE SLOT IN THE HEADWALL
THE RODENT SCREEN SHALL BE FABRICATED FROM FLATTENED EXPANDED METAL WITH SCREEN OPENINGS OF APPROXIMATELY 0 25 SQUARE INCHES THE SCREEN SHALL BE 16 GA METAL AND BE HOT DIP GALVANIZED AFTER FABRICATION
BURLINGTON SEPARATION
ABUTMENT UNDERDRAIN DETAILS
2-138 353L-7
RVUNDRDR 97DLS43 JDS
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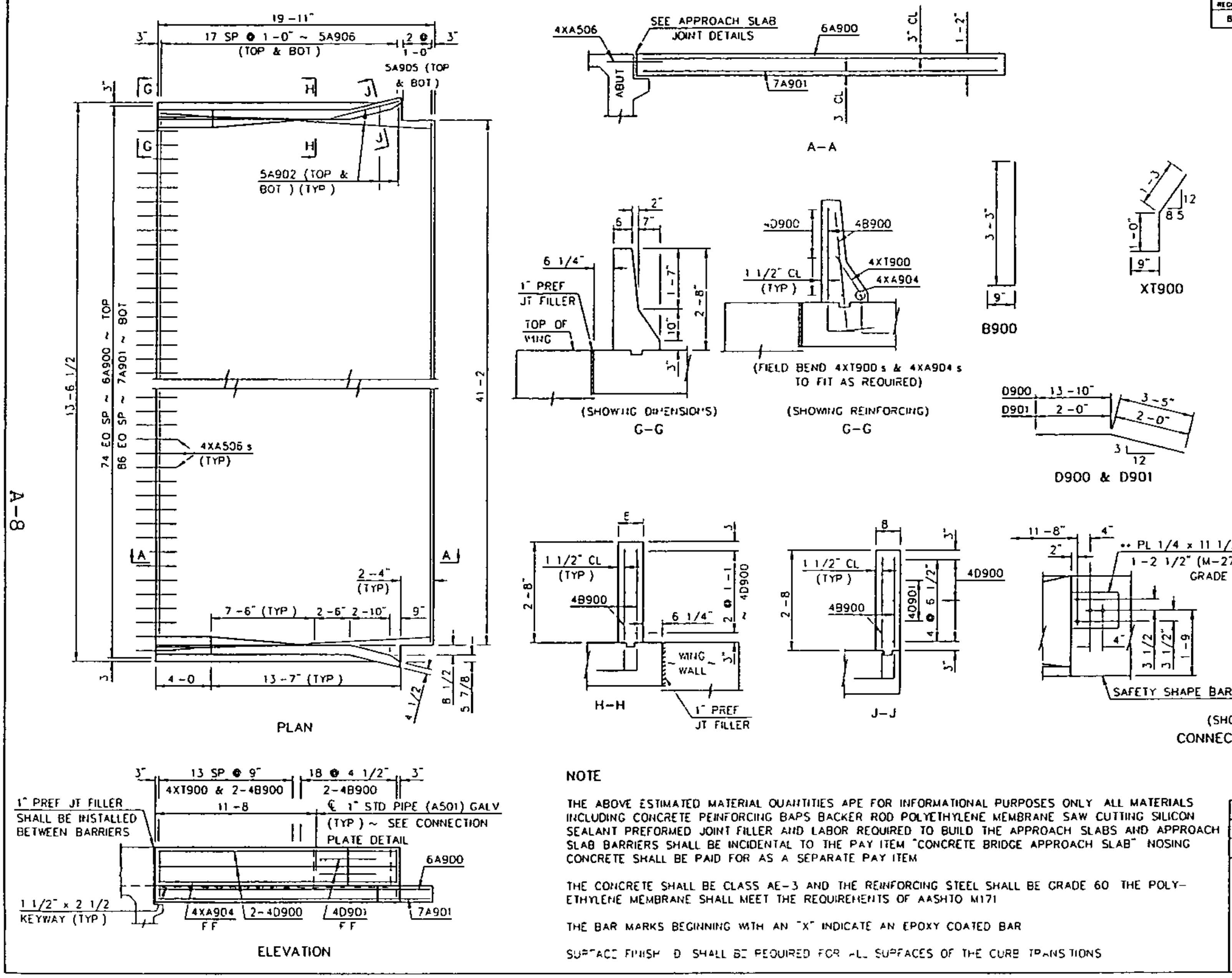
REGION	STATE	FEDERAL AID PROJECT NUMBER	SHEET NO
8	ND	NH-4-002(051)138	44



SKEW ANGLE = 0 DEG			
BAR LIST – ONE SLAB			
SIZE	MARK	NO	LENGTH
6	A900	75	19 -7"
7	A901	87	19 -7"
5	A902	16	6 -0"
4	XA904	2	11 -6"
5	A905	6	40 -10"
5	A906	36	43 -2"
4	B900	132	4 -0"
4	D900	12	17 -3"
4	D901	4	4 -0"
4	XT900	28	3 -0"

ESTIMATED MATERIAL QUANTITIES	
REINFORCING STEEL (LBS)	CONCRETE (C Y)
8238	39 7

NOTE

THE ABOVE ESTIMATED MATERIAL QUANTITIES APE FOR INFORMATIONAL PURPOSES ONLY ALL MATERIALS INCLUDING CONCRETE PEINFORCING BAPS BACKER ROD POLYETHYLENE MEMBRANE SAW CUTTING SILICON SEALANT PREFORMED JOINT FILLER AND LABOR REQUIRED TO BUILD THE APPROACH SLABS AND APPROACH SLAB BARRIERS SHALL BE INCIDENTAL TO THE PAY ITEM "CONCRETE BRIDGE APPROACH SLAB" NOSING CONCRETE SHALL BE PAID FOR AS A SEPARATE PAY ITEM

THE CONCRETE SHALL BE CLASS AE-3 AND THE REINFORCING STEEL SHALL BE GRADE 60 THE POLY-ETHYLENE MEMBRANE SHALL MEET THE REQUIREMENTS OF AASHTO M171

THE BAR MARKS BEGINNING WITH AN "X" INDICATE AN EPOXY COATED BAR

SUPFACE FINISH D SHALL BE PEQUIRED FOR ALL SUPFACES OF THE CURB TPANSITIONS

QUANTITIES	(ONE SLAB)
APPROACH SLAB	95 8 SY
NOSING CONCRETE	40 LF

BURLINGTON SEPARATION

(ENTRANCE END)

APPROACH SLAB DETAILS

2-138 353L-25

PAPPSLAB 97DLS60 JDS
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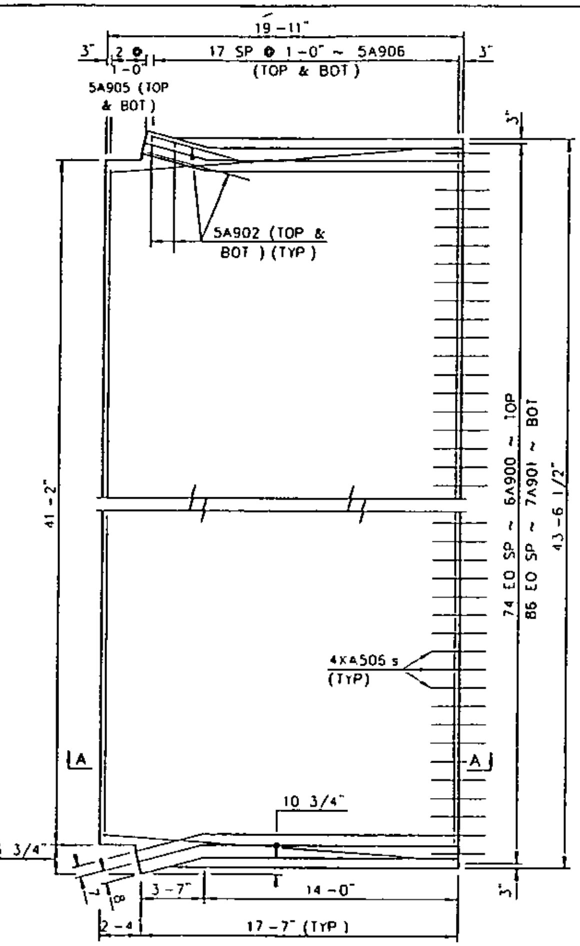
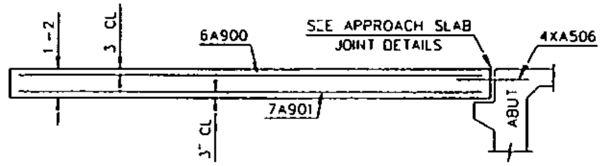
control section

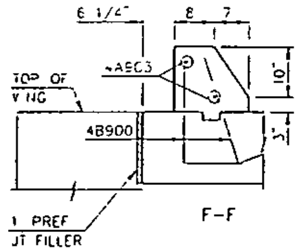
FHWA REGION	STATE	FEDERAL AID PROJECT NUMBER	SHEET NO
8	ND	NH-4-002(051)138	45



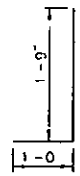
PLAN



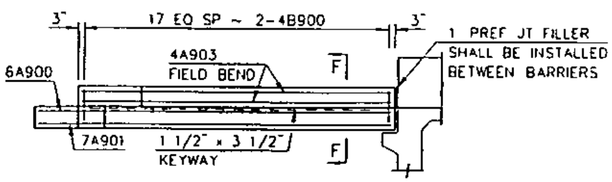
A-A



F-F



B900



ELEVATION

A-9

SKEW ANGLE = 0 DEG			
BAR LIST – ONE SLAB			
SIZE	MARK	NO	LENGTH
6	A900	75	19-7"
7	A901	87	19-7"
5	A902	16	6-0"
4	A903	4	17-5"
5	A905	6	40-10"
5	A906	36	43-2"
4	B900	72	2-9"

ESTIMATED MATERIAL QUANTITIES	
REINFORCING STEEL (LBS)	CONCRETE (C Y)
7844	38 9

NOTE

THE ABOVE ESTIMATED MATERIAL QUANTITIES ARE FOR INFORMATIONAL PURPOSES ONLY ALL MATERIALS INCLUDING CONCRETE REINFORCING BARS BACKER ROD POLYETHYLENE MEMBRANE SAW CUTTING SILICON SEALANT PREFORMED JOINT FILLER AND LABOR REQUIRED TO BUILD THE APPROACH SLABS AND APPROACH SLAB BARRIERS SHALL BE INCIDENTAL TO THE PAY ITEM "CONCRETE BRIDGE APPROACH SLAB" NOSING CONCRETE SHALL BE PAID FOR AS A SEPARATE PAY ITEM

THE CONCRETE SHALL BE CLASS AE-3 AND THE REINFORCING STEEL SHALL BE GRADE 60 THE POLYETHYLENE MEMBRANE SHALL MEET THE REQUIREMENTS OF AASHTO M171

SURFACE FINISH "D" SHALL BE REQUIRED FOR ALL SURFACES OF THE CURB TRANSITIONS

QUANTITIES	(ONE SLAB)
APPROACH SLAB	95 9 SY
NOSING CONCRETE	40 LF

BURLINGTON SEPARATION

(EXIT END)

APPROACH SLAB DETAILS

2-138 353L-26

Control Section

RAPPSLB1 97DLS61 JDS

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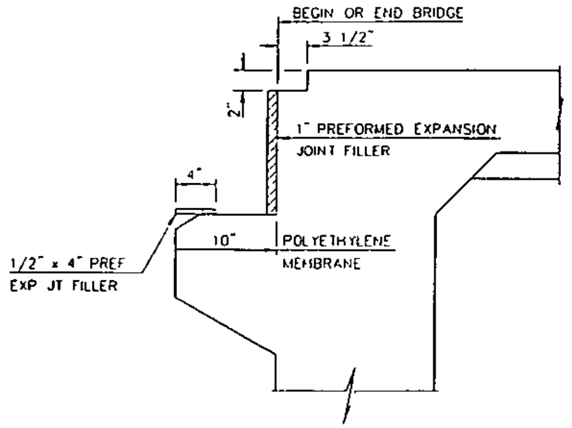
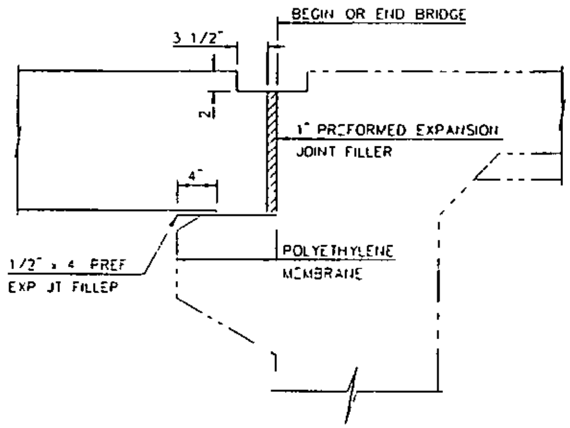
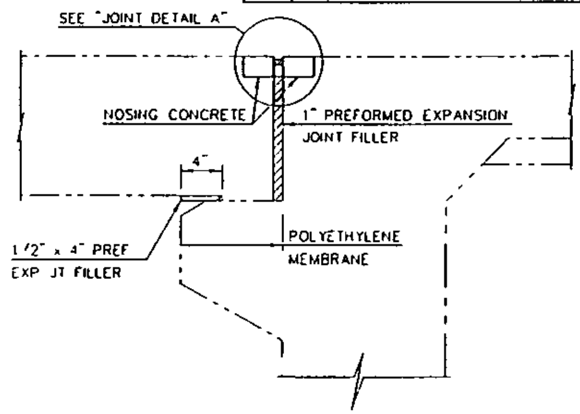
FHWA REGION	STATE	FED AID PROJ NO	SHEET NO
8	N D	NH-4-002(051)138	46



STAGE 1



STAGE 2



STAGE 3

A-10

NOTES

STAGE 1

1 PLACE THE 1" THICK PREFORMED EXPANSION JOINT FILLER THE 1/2" x 4" PPEFORMED EXPANSION JOINT FILLER AND THE POLYETHYLENE MEMBRANE

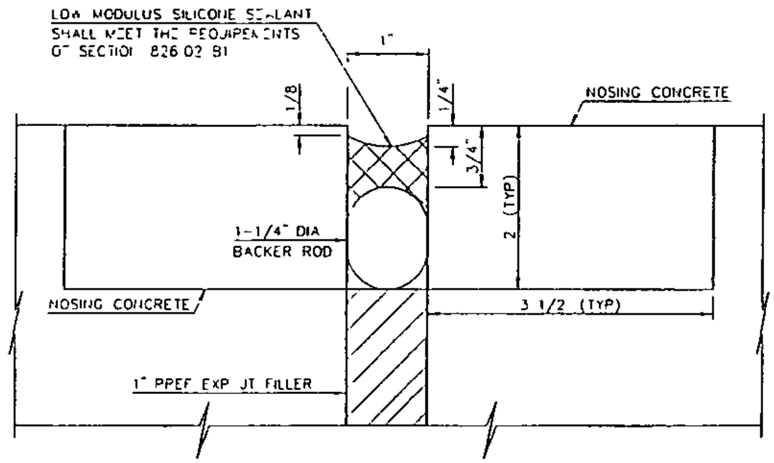
STAGE 2

2 PLACE THE NEW APPROACH SLAB CONCPETE A 2" x 3 1/2" BLOCKOUT SHALL BE FORMED BETWEEN THE CURBS IN THE APPROACH SLAB AS SHOWN

STAGE 3

3 NOSING CONCRETE SHALL BE PLACED IN THE BLOCKOUT AREAS BOTH IN THE ABUTMENT AND IN THE APPROACH SLAB ACCORDING TO THE MANUFACTURERS RECOMMENDATIONS AND INSTALLATION PROCEEDURES

4 AFTER THE NOSING CONCRETE HAS CURED CLEAN THE JOINT AND INSTALL THE BACKER ROD AND THE SILICONE SEALANT ACCORDING TO SECTION 550 04 M 3 OF THE STANDARD SPECS



JOINT DETAIL A

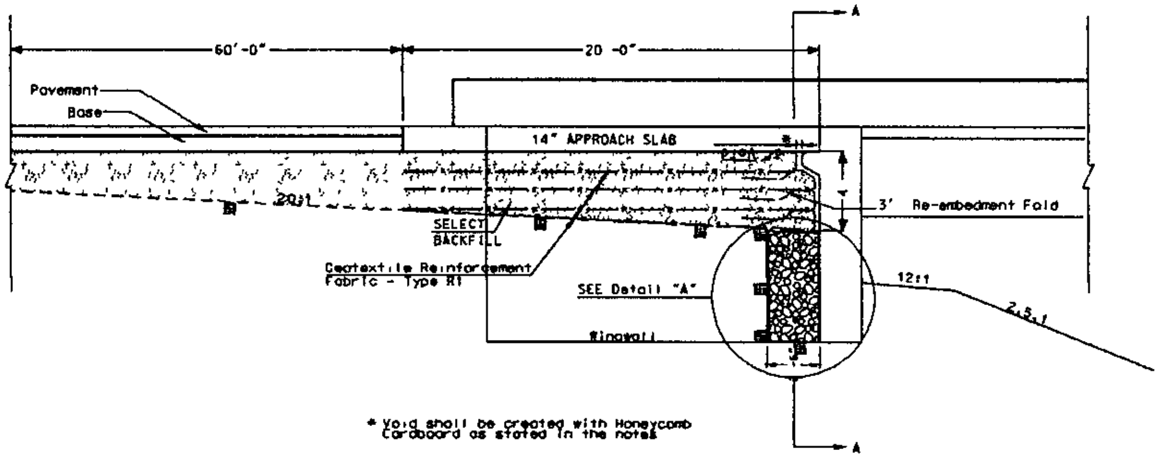
BURLINGTON SEPARATION

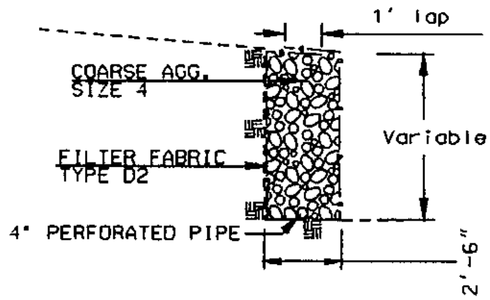
APPROACH SLAB JOINT DETAILS

2-138 353L-27

APPPSLJT 97DLS18 JDS
c \dgn\britnit\apprsljt dgn Sep 19 1997 09 01 06

Appendix B

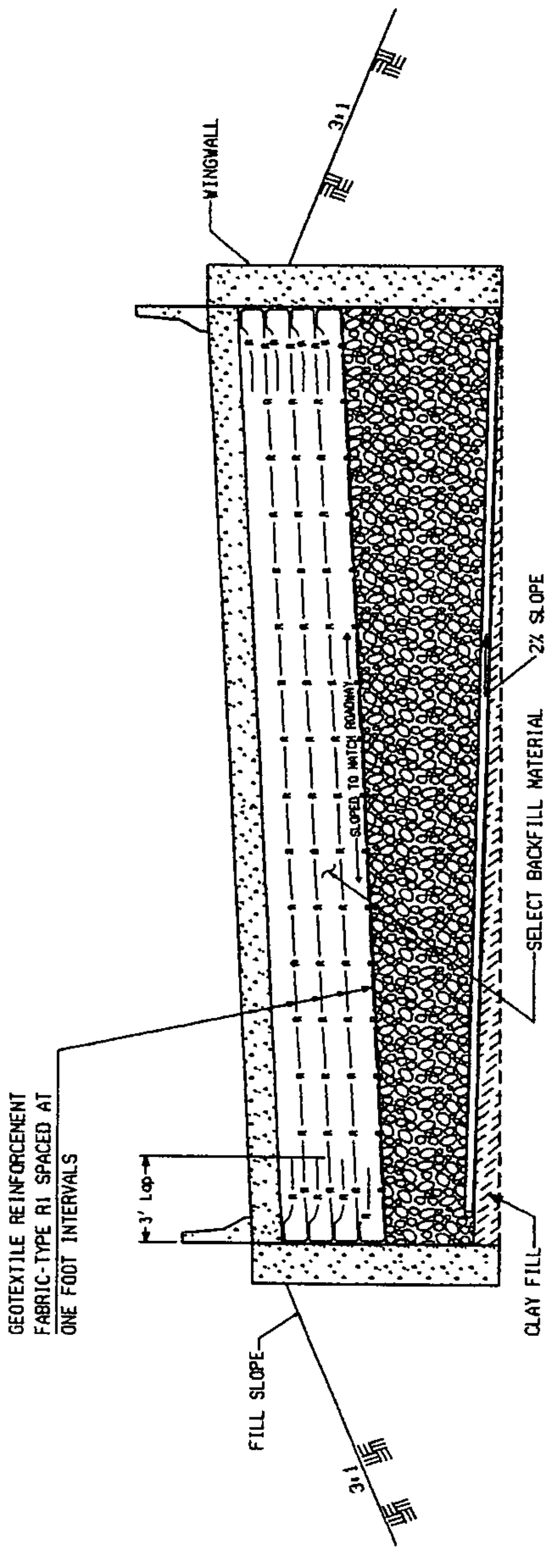




DETAIL "A"

NOT TO SCALE

Detail for Fabric Reinforced Backfill under the Approach Slab
Figure 3


WINGWALL
3:1
2% SLOPE
SELECT BACKFILL MATERIAL
SLOPED TO MATCH ROADWAY
GEOTEXTILE REINFORCEMENT
FABRIC-TYPE R1 SPACED AT
ONE FOOT INTERVALS
3' Lap
CLAY FILL
FILL SLOPE
3:1

SECTION A-A

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

SFN 11570

CHANGE ORDER

SHEET 1

CHANGE ORDER NO 2P 2C

PROJECT NH-4-002(051)138
COUNTY WARD COUNTY
FOR STRUCTURAL, GRADE, SURFACING, & INCID.

CONTRACTOR INDUSTRIAL BUILDERS, INC.
PO BOX 406
FARGO, ND 58078

ORIGINAL CONTRACT AMOUNT
$ 1,545,080.52

DATE 07/08/1998

SPEC NO	CODE NO	ITEM OF WORK	UNIT	ORIG + OR - PREVIOUS CHG QUANTITY	+ OR - QUANTITY	UNIT PRICE	INCREASE AMOUNT	DECREASE AMOUNT
		DECREASE TO BID ITEM						
		PARTICIPATING (NH FEDERAL FUNDS)						
210	198	SELECT BACKFILL	TON	366 000	-366 000	3 000		-7,728 00
		ADDED CONTRACT ITEM						
210	197	SELECT BACKFILL EXPERIMENTAL	L SUM	0 000	1 000	5,327 140	5,327 14	
210	200	SELECT BACKFILL	C.Y	0.000	1,706.000	12 000	20,472 00	

NET INCREASE OR DECREASE TO DATE 19,520 14 PART 0 00 NON-PART

	INCREASE AMOUNT	DECREASE AMOUNT
TOTALS	25,799 14	-7,728 00
NON-PARTICIPATING	0.00	0.00
PARTICIPATING	25,799.14	-7,728.00

DUE TO THIS CHANGE, THE CONTRACT TIME
MAY BE REVISED IF THE WORK AFFECTS/AFFECTED THE CONTROLLING OPERATION.

EXPLANATION OF CHANGE IN PLAN RECOMMENDED

If the Federal Funds authorized in the cost participation agreement with the local agency is exceeded and Federal Funds are not available for this change, the local agency will assume the total cost of this change order.

SEE ATTACHED SHEET

Silas Harris 7-8-98
CONTRACTOR DATE

Ward Swenson 7-8-98
(X)Approval Recommended ( )Approved
PROJECT ENGINEER DATE

CITY/COUNTY/OTHER OFFICIAL DATE

(X)Approval Recommended ( )Approved
DISTRICT ENGINEER DATE 7/8/98

REPRESENTING

Francis J Ziegler 7/9/98
(✓)Approved
REGION ENGINEER DATE

NH-4-002(051)13

CHANGE ORDER 2P, 2C

Spec. Code
210 0197 Select Backfill - Experimental

Materials and Research requested an experimental project be installed on the approach slab by Abut #1 - Right Bridge The experimental project requires an increase in Size 4 Aggregate and Type D2 Filter Fabric quantities It also adds Void Form and Type R1 Geotextile Fabric The following shows the allowable cost of labor, material and equipment, which compare favorably to average annual bid prices

Labor			
	Labor Hours		
	(1 operator, 1 carpenter foreman 2 laborers)	=$56 65 per hour x 20 hrs	=$ 1133 00
	H/W Benefits	=$ 6 60 per hour x 20 hrs	=$ 132 00
	75% Payroll Additive		=$ 849 75
	Subsistence	=$ 7 40 per hour x 20 hrs	=$ 148 00
		Total Labor	=$ 2361 75
Material			
	Geotextile Fabric - Type R1	= 693 sy x $0 88 per sy	=$ 609 84
	Void Form and Freight	= 1 Lump Sum	=$ 835 92
	Additional Size 4 Aggr	= 20 cy x $18 00 per cy	=$ 360 00
	Additional Type D2 Filter Fabric	= 67 sy x $0 99 per sy	=$ 66 33
	5% Sales Tax	=	=$ 93 61
	15% Markup	=	=$ 294 85
		Total Material	=$ 2260 55
Equipment			
	Ford A66 Loader	= $30 71 per hr x 20 hrs	=$ 614 20
	Walk Behind Packer	= $18 92 per hr x 4 hrs	=$ 75 68
	Wacker Packer	= $ 3 74 per hr x 4 hrs	=$ 14 96
		Total Equipment	=$ 704 84
		Grand Total	=$ 5327 14

Spec. Code
210 0198 Select Backfill - Ton
210 0200 Select Backfill - CY

The Select Backfill Quantity in the plans was computed wrong The original plan quantity was computed for the Select Backfill being installed just below the approach slabs, which have 20' lengths The new plan quantity is computed with longer lengths, which are 122', 80' and two at 78' This changes the quantity from 966 tons to 2559 tons

Ongmal Plan Quantity	966 ton x $8 00 per ton	=$ 7,728 00
New Plan Quantity	2559 ton x $8 00 per ton	=$20,472 00

The contractor removed Class 5 from under the SPP Tunnel He proposed to use this matenal for the Select Backfill The matenal was tested and passed for Select Backfill

The pay quantity for Select Backfill was onginally to be paid for by the Ton Now it will be measured and paid for by the CY, in accordance with 210 04 C 2 of the Standard Specifications

2560 ton / 1 875 ton per cy	= 1365 cy
1365 cy x 1 25 for shrinkage	= 1706 cy
2559 ton x $8 00 per ton (bid price)	= $20,472
$20,472 / 1706 cy	= $12 00 per cy

<u>Total Cost of the Select Backfill</u>

$12 00 per cy x 1706 cy	=$20,472 00

This price includes all labor, equipment and matenal necessary to complete the work

CONCRETE, SAND, AND GRAVEL WORKSHEET
Department of Transportation, Materials & Research
SFN 2455 (Rev 4-96)

Project	County
NH - 4 - 002 (051) 138	WARD
Submitted By	**Date Received**
WAYDE SWENSON	5/27/98

~~GRAVEL~~ Select Backfill

Pit Location: Material Reclaimed on Job	
Owner:	
Sampled From: STOCK PILE	
Date Sampled: 5/27/98	Field Sample No: 1
Lab. No:	Size No:

Soundness % Loss – AASHTO T-104 Tested By	
Specific Gravity – AASHTO T-85 Tested By	
% Absorption – AASHTO T-85 Tested By	
L.A. Abrasion (Grad) % Loss – AASHTO T-96 Tested By	
Wt. Rodded Lb./c.f. (Kg/m³) – AASHTO T-19 Tested By	
% Moisture AASHTO T-255 Tested By	

(mm)	Ret	Wt. Ret. Non-Cum	Wt. Ret. Cum.	% Ret.	% Pass	ND Spec.
100	4"					
90	3 1/2"					
75	3"	Ø	Ø	Ø	100	100
63	2 1/2"	—				
50	2"	—				
37 5	1 1/2"	—				
25 0	1"	98 9	98 9			
19 0	3/4"	198.7	297 6			
16 0	5/8"	224 6	522 2			
12 5	1/2"	243 5	765.7			
9 5	3/8"	371 6	1137 3			
4 75	No 4	656 4	1793 7	38 2	61 8	35 - 85
2 36	No 8	530 1	2323 8	49 5	50 5	
Minus No 8		2372 6	4696 4	WET = 4945 0 g		
Wt Check			4696 4	DRY = 4697 1 g		
Original Wt		4697 1		MOISTURE = 5 28 %		
Fineness Modulus						

AASHTO T–27 Tested By ______

W C = 0 01 %

SAND

Pit Location	
Owner	
Sampled From	
Date Sampled	Field Sample No
Lab No	

Soundness % Loss – AASHTO T-104 Tested By	
Specific Gravity – AASHTO T-84 Tested By	
% Absorption – AASHTO T-84 Tested By	
Color – AASHTO T-21 Tested By	
Wt. Loose Lb./c.f (Kg/m³) – AASHTO T-19 Tested By	
% Moisture AASHTO T-255 Tested By	

(mm)	Ret.	Wt. Ret. Non-Cum	Wt. Ret. Cum.	% Ret.	% Pass	ND Spec.
9 5	3/8"	Ø	Ø			
4 75	No 4	Ø	Ø			
2 36	No 8	Ø	Ø			
2 00	No 10	—				
1 18	No 16	101 9	101 9			
600um	No 30	119 0	220 9	38 4	61 6 / 31.1	20 - 50
425um	No 40	—				
300um	No 50	116 5	337 4			
150um	No 100	81 9	419 3			
75um	No 200	30 6	449 9	78 2	21 8 / 11 0	0 - 15
Minus No. 200 (75um)		18 7	468 6			
Original Wt		575 1		W C = 0 11 %		
Wt After Wash		463 1				
Wash Loss		107 0				
Wt Check			468 6			
Fineness Modulus						

*Attention Advised

AASHTO T–11 Tested By ______
AASHTO T–27 Tested By ______

☐ ______________ District
☐ Central Lab

5/27/98
Date

Travis Lord
Testing Lab Supervisor

Distribution Central Office/Lab
District Engineer
Res Engineer

North Dakota State Highway Department

CONCRETE PROPORTION DESIGN

PROJECT: NH-4-002(051)138 CONTRACTOR: INDUSTRIAL BUILDERS, INC.
TYPE OF WORK: STRUCTURE

DESIGN NO.: 4 DATE: 05/07/98 CLASS OF CONCRETE: AAE-3

TYPE & BRAND OF CEMENT:

SOURCES: Cement LAFARGE ; Sand GRAVEL PRODUCTS ; Rock GRAVEL PRODUCTS

SPECIFIC GRAVITIES:
Gc= 3.14 (Cement); Gfa= 2.57 (Flyash); Gs= 2.66 (Sand); Gr= 2.69 (Rock)*
*(Combine if two rock sizes)

PERCENT OF TOTAL AGGREGATE (by weight):
S= 38% Sand, Ra= 62 % Size 3 Rock; Rb= 0 % Size Rock

CALCULATIONS: (for 27 C.F. Batch Size)

PROPORTIONS		LBS/BATCH		C.F.
CEMENT:	(94lbs/Sack) x (6 5 Sacks/C Y) x (27 /27) Adjusted to 5 5 Sacks/C Y for Flyash	: 519.35	C=	2.65
FLYASH:	20 % Flyash used	122.20	FA=	0.76
WATER:	(4 3 Gal/Sack) x (8 33) x 6 5 Sacks Cement/C Y. (includes free moisture in aggregates)	: 232.82	W=	3.73
AIR:	6 50 % (assumed entrained air in mix)	XXXXXX	A=	1.76

Dry Wt., T= 3025.53	Absolute Volume, V, of Total Aggregate		V=	18.10
	Combined Specific Gravity of Total Aggregate			2.68
SAND, Dry Wt.	=	1149.70	S=	6.93
ROCK, Size 3, Dry W .	=	1875.83	R=	11.18
ROCK, Size , Dry Wt.	=	0.00		
TOTAL WEIGHT PER BATCH	=	3899.90	BATCH SIZE =	27.00

CALCULATED UNIT WEIGHT = 144.44 lbs/C.F.

Wayde Swenson
Engineer

MATERIAL TESTING SERVICES, INC.

P O Box 634
Minot ND 58702
(701) 852 5553

COMPRESSION TESTS OF CONCRETE CYLINDERS

P O Box 1093
Williston ND 58802
(701) 572-4226

'OJECT NH-4-002(051)138 DATE October 12, 1998

REPORTED TO North Dakota Department of Transportation
PO Box 1396
Minot, North Dakota 58702

COPIES TO

Laboratory Number 98-094

FIELD DATA					
Job Identification	68				
Date Cast	9/14/98				
Age To Be Tested (days)	28				
Slump (if given)	2-3/4"				
Air Content (if given)	6 0%				
Unit Weight (if given)	145 8 lbs				
Location of Pour	Right bridge, deck and approach slab				
Cylinders Submitted By	North Dakota Department of Transportation				

CONCRETE MIX	
Specified Strength at 28 days	AAE-3
crete Mix Proportions	
Cement	
Fine Aggregate	
Coarse Aggregate	
Admixture 1	
2	
3	
Concrete Furnished by	

COMPRESSIVE STRENGTH	Test Method - ASTM C 39, 6" x 12" Cylinder				
Laboratory Number	126 A				
Date Received	9/15/98				
Days on Job and in Transfer	1				
Days Cured-ASTM C 192	27				
Days of Age at Test	28				
Gross Load at Failure (pounds)	130,000				
Compressive Strength (psi)	4590				
Compressive Strength (MPa)	31 7				

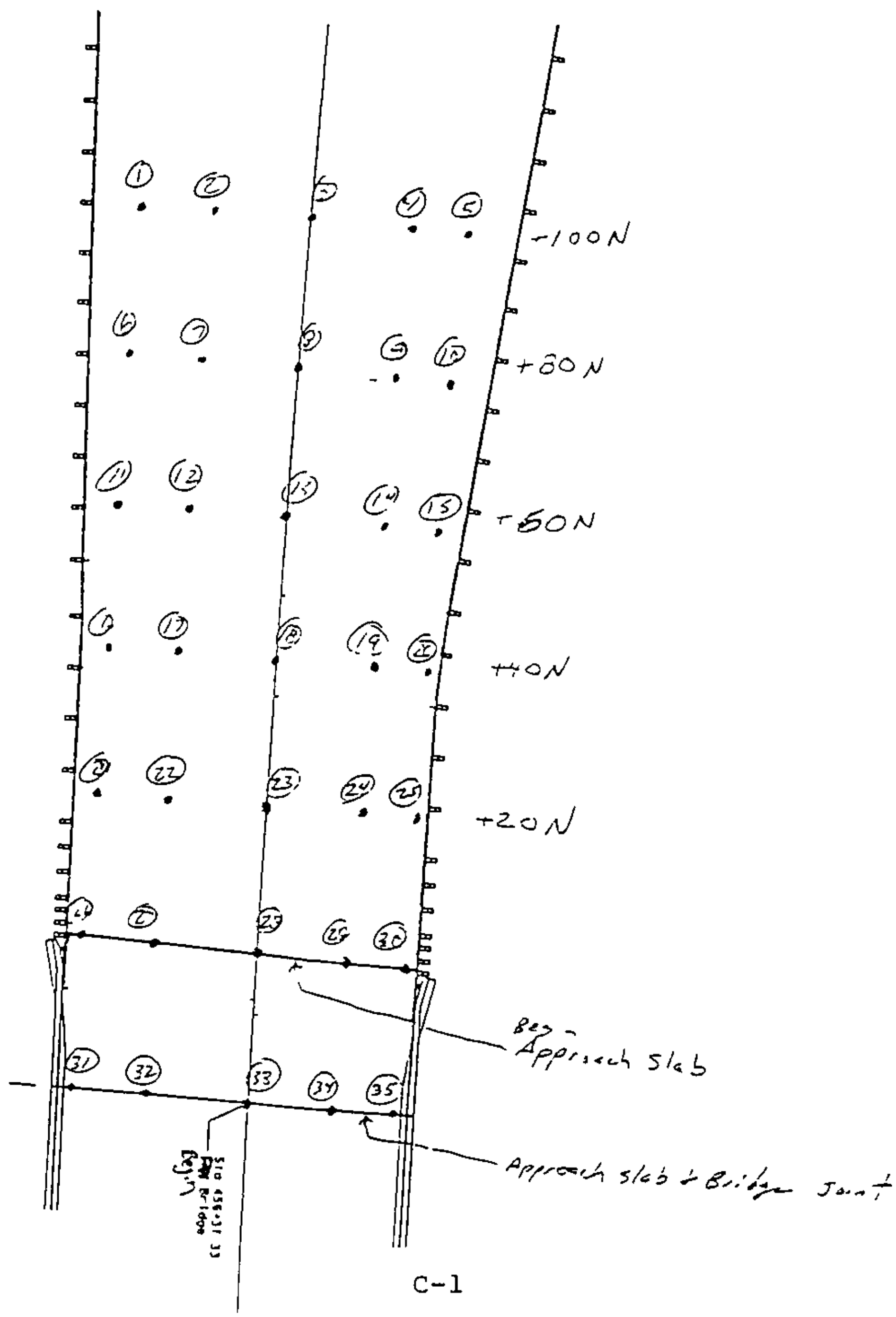
REMARKS

Material Testing Services, Inc

by Stan Wald

Appendix C


N


+100N
+80N
+60N
+40N
+20N
Beg. Approach Slab
Approach slab + Bridge Joint

10/27/98 Stambaugh π, Swenson ϕ

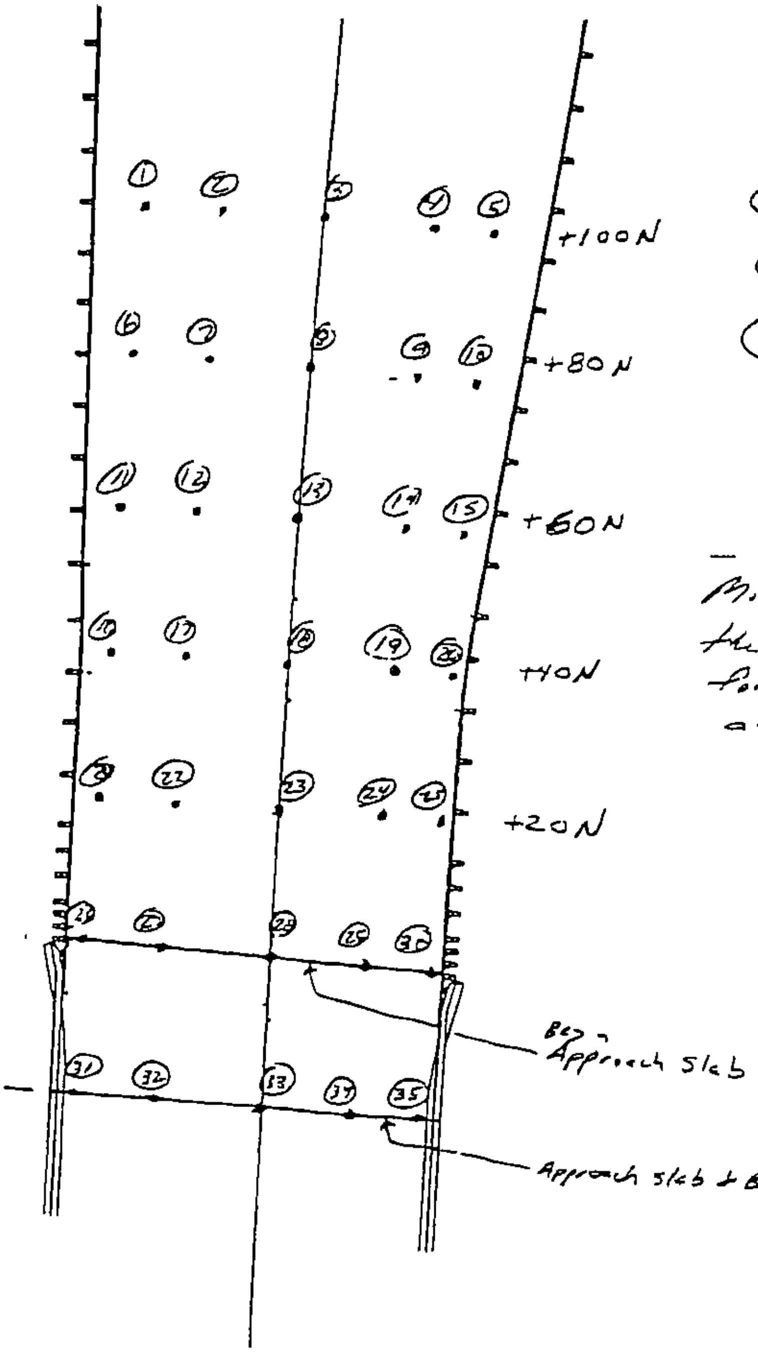
Eastbound Cross-Section of Abut #1 Appr. - Rt Bridge

BM #6A 8.69 1690.13 1681.44

Appr Slab	(30) 5.51 18 84 62	(29) 5.25 12 84 58	(28) 4.79 ℄ 85 34	(27) 4.32 12 85 81	(26) 3.89 22 86 [illegible]
20' N	(25) 5.58 18 84 55	(24) 5.21 12 84 92	(23) 4.66 ℄ 85 47	(22) 4.16 12 85 97	(21) 3.91 22 [illegible]
40 N	(20) 5.57 18 84 56	(19) 5.22 12 84 91	(18) 4.54 ℄ 85 57	(17) 4.03 12 86 10	(16) 3.73 22 [illegible]
60 N	(15) 5.62 18 84 51	(14) 5.20 12 84 93	(13) 4.56 ℄ 85 57	(12) 4.06 12 86 07	(11) 3.78 22 [illegible] 35
80' N	(10) 5.72 18 [illegible]	(9) 5.25 12 84 88	(8) 4.62 ℄ 85 51	(7) 4.08 12 86 05	(6) 3.79 22 [illegible]
100' N	(5) 5.72 18 [illegible]	(4) 5.29 12 [illegible]	(3) 4.69 ℄ 85 [illegible]	(2) 4.13 12 [illegible]	(1) 3.81 22 [illegible]
Deck/ Appr Slab	(35) 5.52 13 [illegible]	(34) 5.29 12 84 84	(33) 4.78 ℄ 85 35	(32) 4.23 12 85 85	(31) 3.87 22 [illegible]

1	86.30
2	85.97
3	85.40
4	84.79
5	84.35
6	86.33
7	86.04
8	85.50
9	84.83
10	84.35
11	86.30
12	86.07
13	85.57
14	84.87
15	84.47
16	86.32
17	86.07
18	85.55
19	84.85
20	84.50
21	86.17
22	85.92
23	85.42
24	84.85
25	84.48
26	86.11
27	85.70
28	85.25
29	84.79
30	84.51
31	86.20
32	85.79
33	85.26
34	84.79
35	84.56

EASTBOUND BRIDGE



Post-it® Fax Note 7671
Date 11/22/95
# of pages 2
To Mike M.
From W. Sweeten
Co/Dept Mat'l & Res.
Co MINOT DIST
Phone # 837-7620
Fax # 837-7632

Mike, here are the elevations for the bridges at Burlington

Wayne

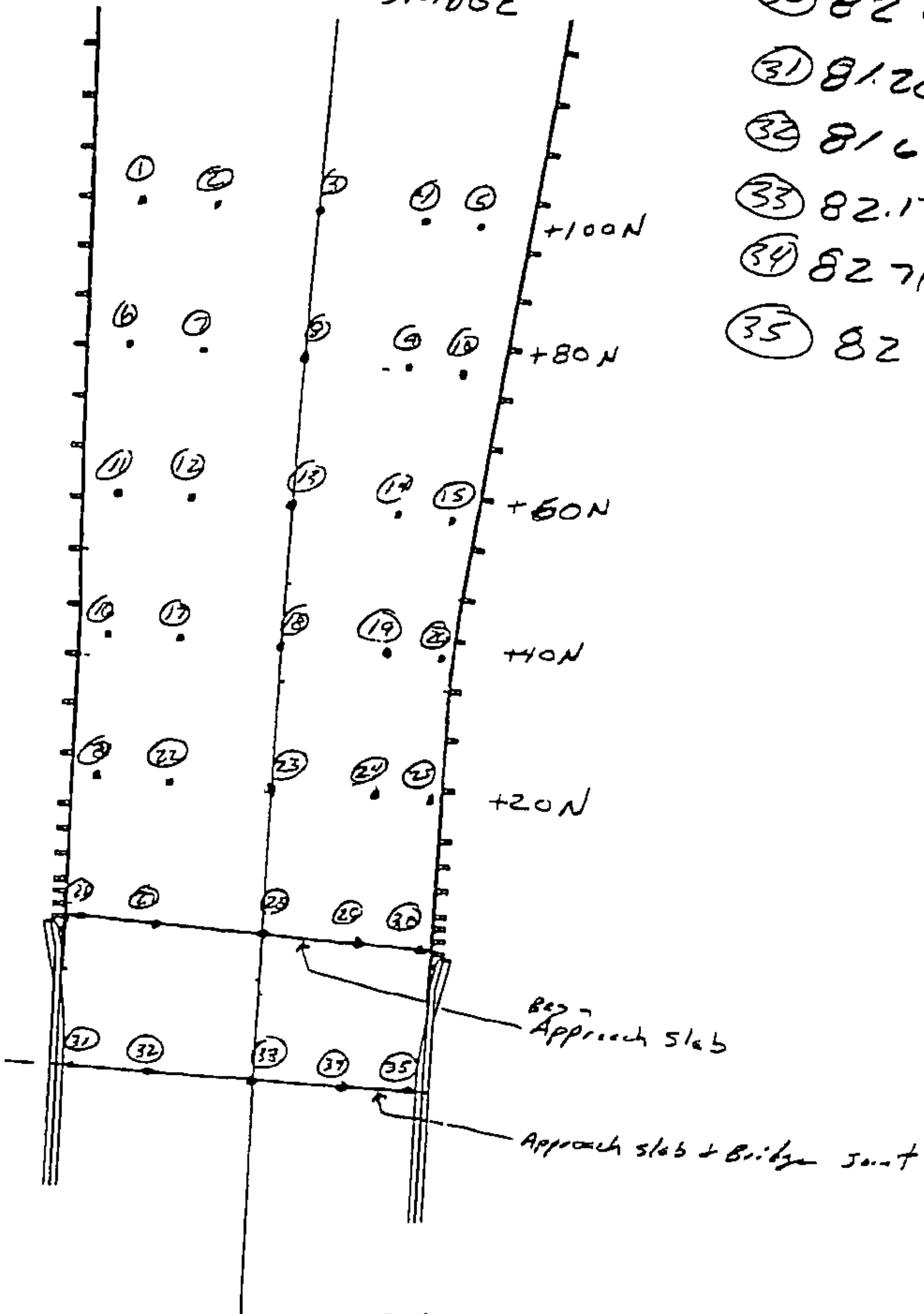
1 80.26
2 80.60
3 81.18
4 81.70
5 81.79
6 80.47
7 80.81

8 81.42
9 81.93
10 82.01
11 80.66
12 81.07
13 81.59
14 82.11

15 82.23
16 80.84
17 81.28
18 81.76
19 82.25
20 82.31
21 81.01

22 81.50
23 81.94
24 82.38
25 82.48
26 81.07
27 81.44
28 82.01
29 82.54
30 82.80
31 81.28
32 81.67
33 82.17
34 82.71
35 82.94

WEST BOUND BRIDGE

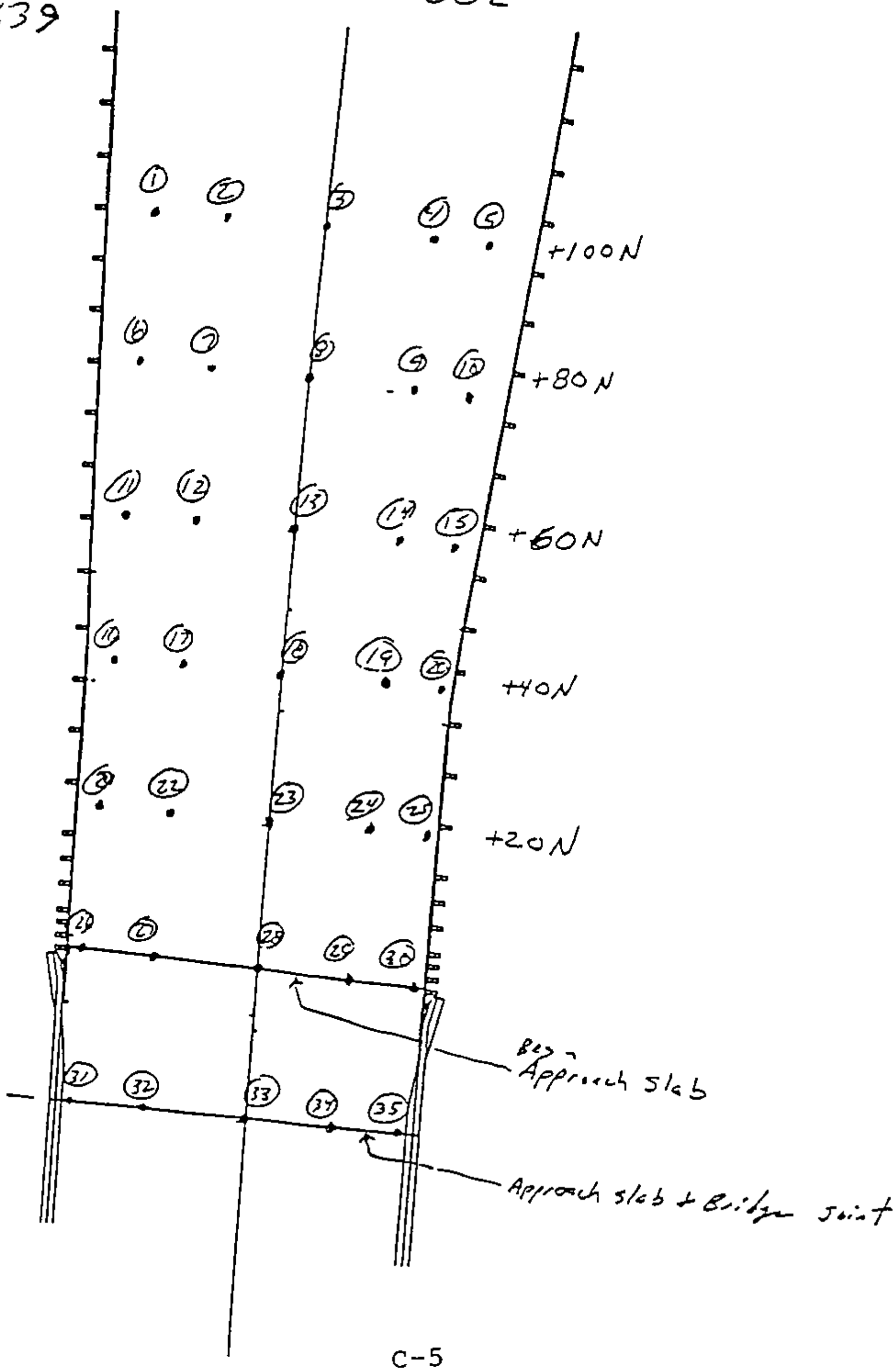


1 86.11	11 86.23	21 86.06	26 85.93	31 86.13
2 85.81	12 85.92	22 85.83	27 85.54	32 85.73
3 85.21	13 85.41	23 85.32	28 85.07	33 85.21
4 84.63	14 84.74	24 84.70	29 84.60	34 84.72
5 84.09	15 84.34	25 84.37	30 84.37	35 84.49
6 86.19	16 86.22			
7 85.89	17 85.97			
8 85.34	18 85.45			
9 84.68	19 84.73			
10 84.21	20 84.39			

4

2001

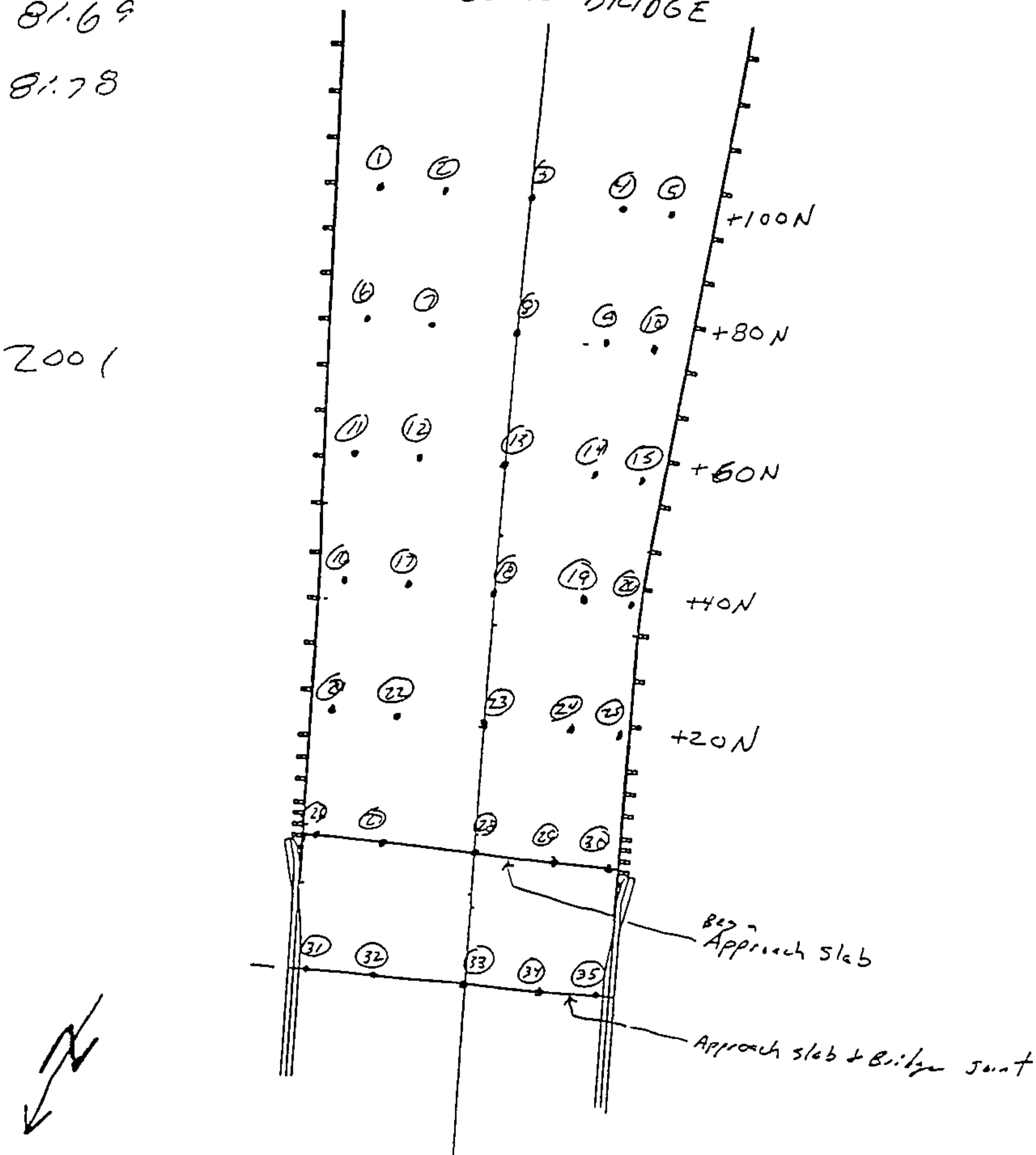
EASTBOUND BRIDGE



1 79.96 E
2 80 31
3 80.91
4 81 46
5 81 55
6 80.19 E
7 80.55
8 81 15
9 81.69
10 81.78
11 80.48 E
12 80 87
13 81 35
14 81.88
15 82 02
16 80 64 E
17 81 08
18 81.55
19 82 06
20 82.10
21 80.83 E
22 81 31
23 81 74
24 82 20
25 82 30
26 80 89 E
27 81 28
28 81 83
29 82.36
30 82.60
31 81 12 E
32 81 47
33 82.02
34 82.57
35 82.80

WEST BOUND BRIDGE

2001

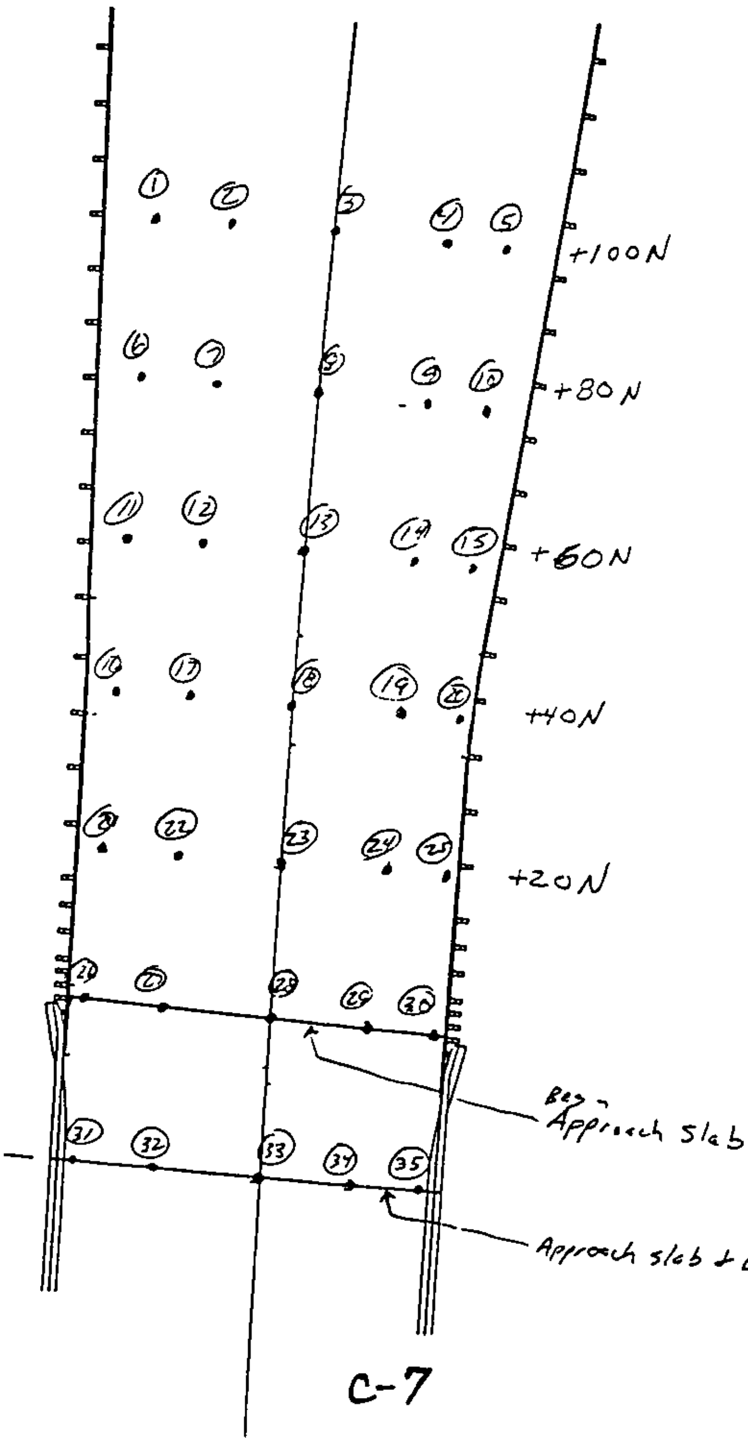


1 86.08
2 85.78
3 85.18
4 84.61
5 84.08
6 86.17
7 85.86
8 85.31
9 84.67
10 84.20
11 86.22
12 85.90
13 85 40
14 84.73
15 84.33
16 86.21
17 85.96
18 85.43
19 84.72
20 84.39
21 86.05
22 85.82
23 85.30
24 84.70
25 84.36
26 86.05
27 85.67
28 85.12
29 84 70
30 84.46
31 86.12
32 85 72
33 85.19
34 84 73
35 84.48

N

2002

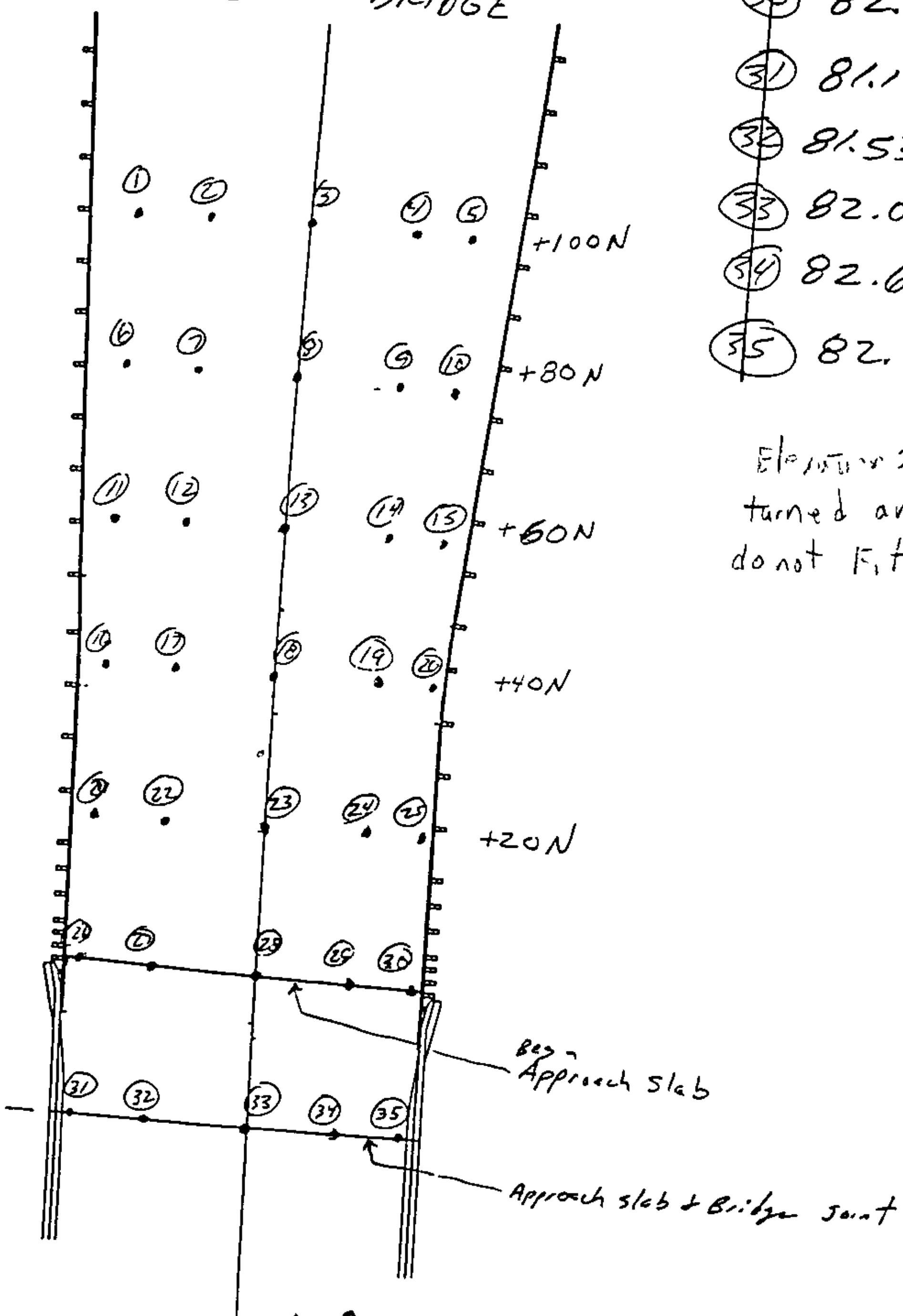
EASTBOUND BRIDGE



1	80.02	5
2	80.37	4
3	80.63 ~~80.97~~	3
4	81.51	2
5	81.61	1
6	80.25	10
7	80.61	9
8	81.21	8
9	81.74	7
10	81.84	6
11	80.53	15
12	80.93	14
13	81.41	13
14	81.94	12
15	82.08	11
16	80.70	20
17	81.140	19
18	81.61	18
19	82.12	17
20	82.17	16
21	80.89	25
22	81.37	24
23	81.80	23
24	82.76	22
25	82.36	21
26	80.95	30
27	81.32	29
28	81.88	28
29	82.43	27
30	82.66	26
31	81.17	35
32	81.53	34
33	82.08	33
34	82.64	32
35	82.87	31

WEST BOUND BRIDGE

2002



Elevations must be turned around - they do not Fit. 6-25-03

π Heilman
Ide
Effertz

NH-4-052(051)138

6-23-03
sunny mid 70s
minimal wind

Eastbound

BM#1	8.22	1690.82 π			1682.60
	84.48	84.71	85.20	85.70	86.11
Deck/slab	6.34	6.11	5.62	5.12	4.71
	18	12	℄	12	22
	84.34	84.64	85.05	85.62	86.04
slab/Hwy	6.48	6.18	5.77	5.20	4.78
	84.34	84.67	85.28	85.80	86.03
20'	6.48	6.15	5.54	5.02	4.79
	84.37	84.71	85.43	85.95	86.19
40'	6.45	6.11	5.39	4.87	4.63
	84.32	84.72	85.39	85.89	86.20
60'	6.50	6.10	5.43	4.93	4.62
	84.20	84.65	85.31	85.85	86.16
80'	6.62	6.17	5.51	4.97	4.66
	84.07	84.60	85.17	85.77	86.06
100'	6.75	6.22	5.65	5.05	4.76
BM#1 ✓	8.22				

Westbound

BM#2	8.99		84.23 π			1695.24
	18	12	℄	12	22	
	82.87	82.64	82.09	81.54	81.20	
Deck/slab	1.36	1.59	2.14	2.69	3.03	
	82.65 / 84.23	82.42	81.88	81.31	80.94	
Slab/Hwy	1.58	1.81	2.35	2.92	3.29	
	82.36	82.26	81.80	81.37	80.88	
20'	1.87	1.97	2.43	2.86	3.35	
	82.16	82.12	81.61	81.14	80.68	
40'	2.07	2.11	2.62	3.09	3.55	
	82.08	81.95	81.41	80.93	80.54	
60'	2.15	2.28	2.82	3.30	3.69	
	81.84	81.74	81.22	80.61	80.25	
80'	2.39	2.49	3.01	3.62	3.98	
	81.61	81.51	80.63	80.37	80.02	
100'	2.62	2.72	3.60	3.86	4.21	
BM#2 ✓	8.99					

Recorded 6-25-03 98-06_3A.WB3

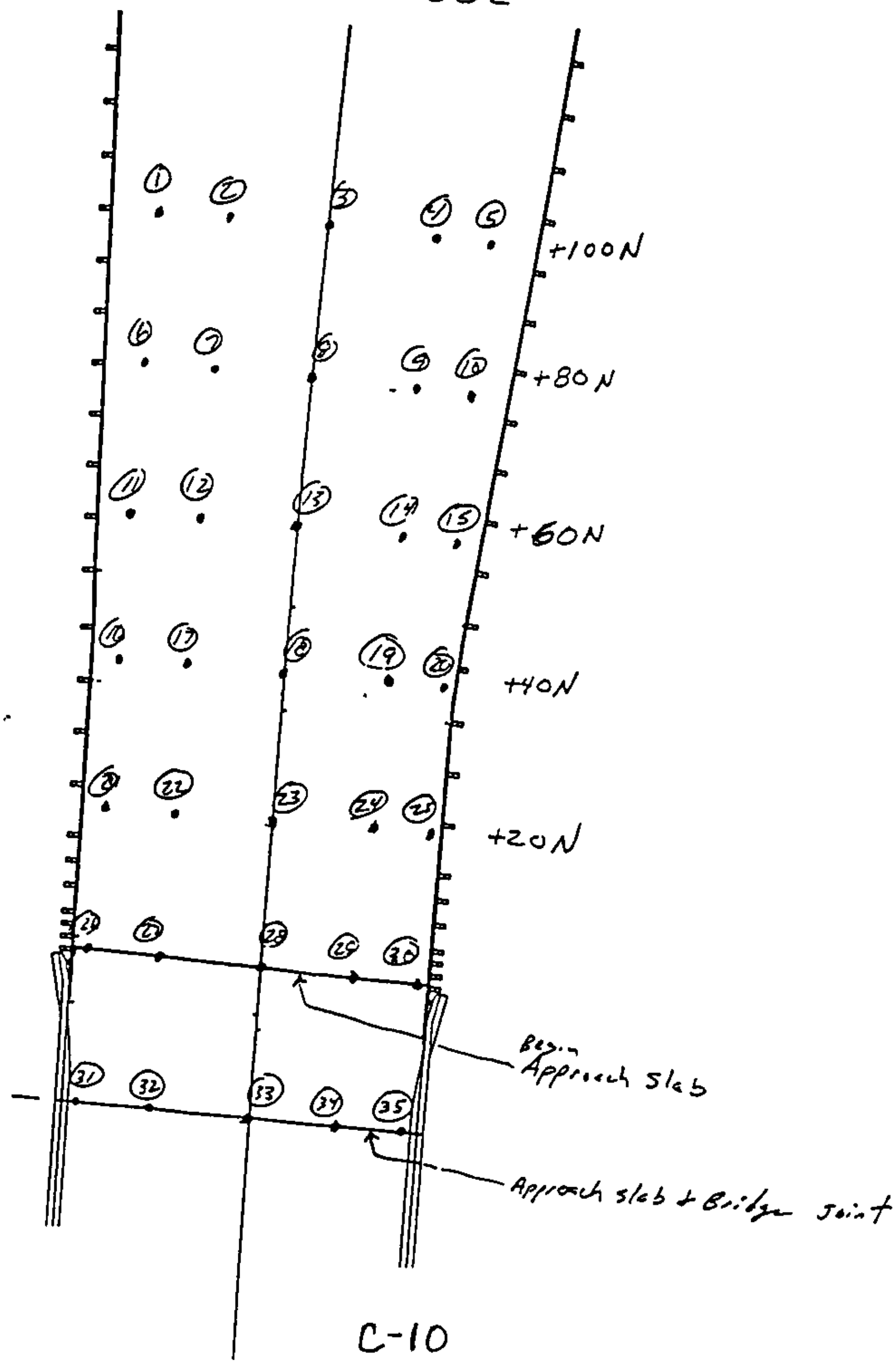
June 2003 data
before mudjacking slabs

3/31/04
Stambaugh π
Harbaugh φ
Dodgen φ

Sunny, high 40's, wind 20-25 mph.

1	86.04
2	85.72
3	85.11
4	84.60
5	84.07
6	86.08
7	85.79
8	85.20
9	84.64
10	84.18
11	86.18
12	85.89
13	85.34
14	84.69
15	84.34
16	86.22
17	85.93
18	85.42
19	84.75
20	84.48
21	86.21
22	85.98
23	85.46
24	84.75
25	84.51
26	86.05
27	85.83
28	85.32
29	84.72
30	84.47
31	86.11
32	85.70
33	85.23
34	84.73
35	84.50

EASTBOUND BRIDGE



C-10

3/31/04

Stambaugh π
Harbaugh Φ
Dodgen Φ

sunny, high 40's, wind 20-35mph

1. 80.00
2. 80.35
3. 80.95
4. 81.49
5. 81.58
6. 80.23
7. 80.59
8. 81.19
9. 81.72
10. 81.82
11. 80.52
12. 80.86
13. 81.39
14. 81.92
15. 82.06
16. 80.64
17. 81.05
18. 81.60
19. 82.10
20. 82.14
21. 80.86
22. 81.31
23. 81.77
24. 82.23
25. 82.33
26. 81.05
27. 81.41
28. 81.95
29. 82.49
30. 82.72
31. 81.16
32. 81.50
33. 82.05
34. 82.60
35. 82.84

WEST BOUND BRIDGE